AMERICAN MACHINIST

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Garboard Strake Bender.

The illustration on this page is of a machine built by the W. & S. Hydraulic Machinery Works, 204–210 East 43d street, New York, for the Samuel L. Moore & Sons Co., for bending keels, garboard strakes and similar work.

The frame of this machine is built up of wrought-iron plates, varying in thickness from ½″ to 1″; the bending beam is 18 feet long; the space between the bending beam and the upright is sufficient to permit plates 72″ wide to be bent, and with 1,500 pounds water pressure the bending force exerted is 175 tons.

There are two cylinders, one at either end, for forcing the beam down, and two smaller ones for lifting it, each cylinder being single acting, and arranged so that they can be worked together in pairs, or singly, to give any desired inclination to the beam, the connections to which are of such character as will allow one end of the beam to be lower than the other. The main cylinders are 12″ diameter, and the plungers of these merely rest upon the beam upon a curved seat—the guides at either end of the beam being curves which are struck from the center of the opposite guide in each case, so there can be no cramping. Water is admitted to the cylinders by valves moved by levers, and there are also throttling valves by which the speed of the movement may be independently regulated.

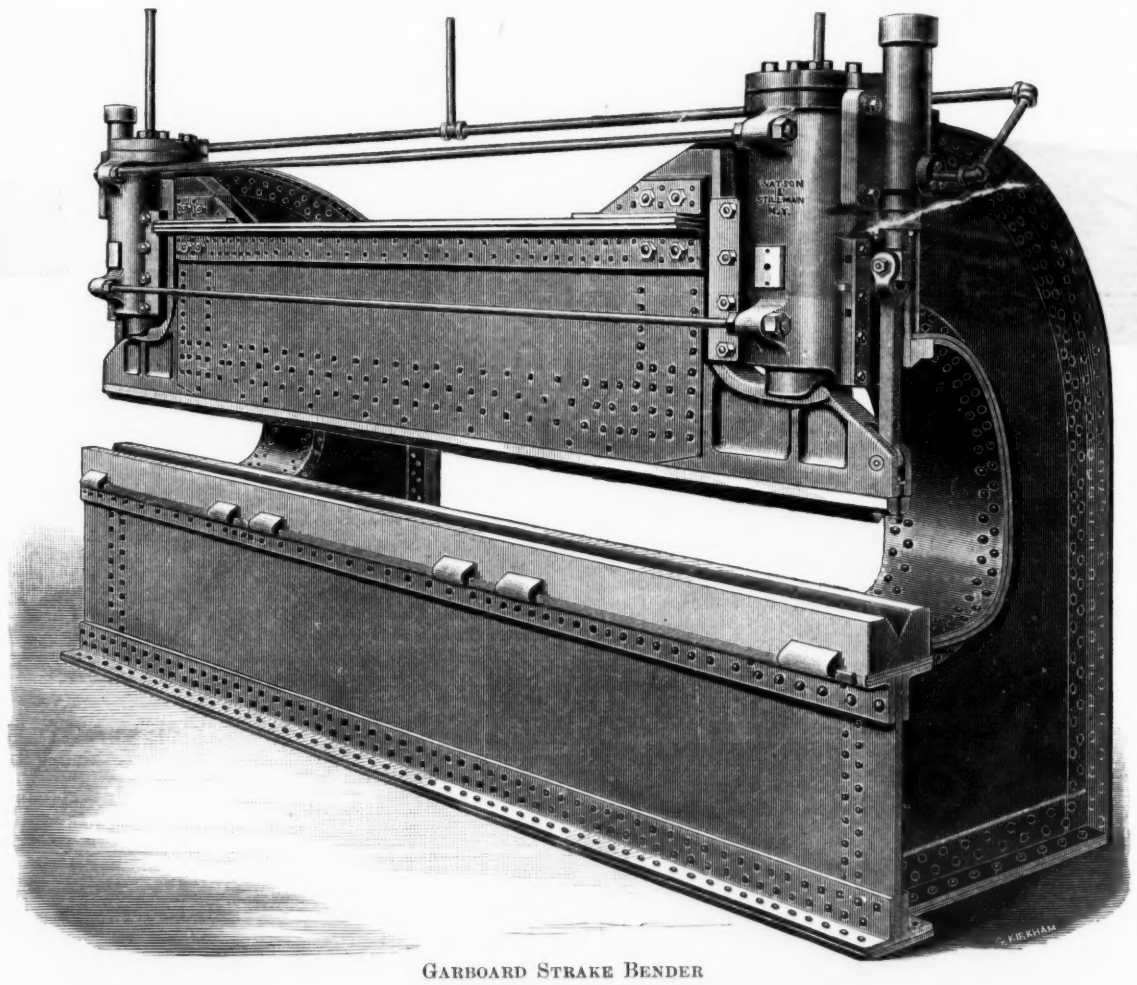
Ordinarily the pressure is maintained in the lifting cylinders at all times, the effective cylinder area being the difference in area between the two pairs of cylinders; but where it is necessary to do so the water can be released from the small lifting cylinders and the full area of the larger ones used. No loss occurs from this method of working, since the smaller cylinders are in communication with the accumulator, while the advantage of it is that their action is always prompt and automatic.

The lifting cylinders are attached to the side of the larger ones by tongues and grooves as well as bolts, and crossheads are provided below the lifting cylinders, to which the links or rods are connected which are attached to the beam. Square keys can be placed under these crossheads to hold the beam up when the water is to be released from all the cylinders, and, by putting these keys above the crossheads the upward movement of the beam can be limited to no more than is necessary for the work to be done, so that waste of water is prevented.

Automatic relief valves are provided for each cylinder, so that by no possibility can the movement of the beam be blocked near one end, so that either of the other cylinders can be used to make a lever out of it to wreck the machine.

The levers and valves by which all movements of the machine are controlled are placed in this instance about 20 feet from the machine, in order to be out of the way, and are worked by an attendant who is guided by signals from the man who is doing the bending.

By the adoption of rolled iron and steel in the construction of this machine the builders have attained great strength and stiffness with comparatively light weight, and the machine has proven in use to be highly efficient.



GARBOARD STRAKE BENDER

A man who is in the buying business can, in these times, find reasons presented to him, without cost, for buying almost any quality of goods desired. The machinist, for example, can find tools made to any degree of refinement. In buying he should use his best judgment. There is no doubt that some tools cost too much for the common rough work of an ordinary machine shop. The tool makers' lathe would be out of place on rough work. It would be less effective than the more ordinarily constructed machine. But for all this there is, and ought to be, a tendency towards the use of better machine tools. As the demand for better tools increases, better means of making come in vogue, till the high-priced machine of this year becomes the cheap machine of two years later. It is the demand that guarantees the supply, in machine tools, or steam engines, just as it does in everything else. We cannot find a machine tool too good, unless the quality of *goodness* costs us too much money. All the tendency is to decrease the cost.

Condition and Prospect of the Machinery Business.

LETTERS FROM PROMINENT ESTABLISHMENTS TO THE "AMERICAN MACHINIST."

Darling, Brown & Sharpe (U. S. Standard Rules, Patent Hardened Cast-steel Try Squares, etc.), Providence, R. I., write us:

The demand for our products is still greater than our ability to supply, but with additions made during the present year, and others contemplated in 1893, we expect to be able to fill orders more promptly than heretofore. The prospect for business seems encouraging.

The Conover Mfg. Company (Independent Belt and Steam-driven Air and Circulating Pumps and Condensers), New York, write us:

Our business for 1892 has been very satisfactory, as we have made a great many more sales than we expected to at the beginning of the year. While we have sold a goodly number of small and medium sized condensers, the greater part of our business has been in connection with condensers of large capacity. We have a number of new customers, and are especially pleased that we are receiving orders from all parts of the country, particularly the Pacific coast.

We have endeavored to furnish a condenser, the cost of operating which approaches the economy of modern engine practice, and the kind words from the many users of the machine make us feel that we have succeeded fairly well.

With largely increased facilities, and condensers of 500 H. P. and under in stock for immediate delivery, and confidence in our ability to render good service to our customers for the coming year, we feel that we shall do a very good business.

E. G. Smith (Machinists' Fine Tools), Columbia, Pa., writes us:

I am pleased to say that business during 1892 was very satisfactory. My latest improved extension surface gauge is well liked among machinists for general work, owing to its simplicity and low price. The demand for my graduated beam or sliding caliper is also increasing, as professors of drawing schools and universities, machinists and mechanics in general are beginning to appreciate the utility and convenience of my calipers, and orders are coming in lively from all parts of the country. I also find there is an increasing demand for sliding calipers with metric measurement, especially those graduated in millimeters with vernier to read one tenth millimeter, of which kind I furnished several universities for their Department of Physics. The metric system, with its many advantages, seems to be gaining foothold rapidly. The list of separate parts for surface gauges and micrometers is also well patronized, as it comprises such parts as cannot readily be bought or made. Prospects for 1893 are very encouraging.

Dietz, Gang & Co. (Patent Radial Drills, and other Machine Tools), Cincinnati, O., write us:

We are pleased to report that we have increased our business to double the amount of last year, and are looking for a larger place, and intend to put in a number of new tools as soon as we find a suitable place. The increase in our business is due to our new patent radial drill, and our new improved 22″ engine lathe, which fill a long-felt want. We have at present a number of unfilled orders on hand from all over the country, especially from the East. We have an order from a well-known concern for two of our new 52″ patent radial drills, with power revolving table. All our machines are original, and are not copied from others. Prospects for the coming year are very good, notwithstanding the fact of the change in the administration.

Chandler & Taylor Co. (Engines, Boilers, Saw-mills), Indianapolis, Ind., write us:

Our observation has been that the volume of trade during the present year has been steadily on the increase, not only with our domestic trade, but also with our export trade.

Collections seem to be fair, although not so good as they might be for this time of year. As to the prospects for next year we cannot predict. We hope for a continuation of present volume of business, but will not purchase largely until we ascertain the effect of the policy of the incoming administration upon prices.

The Vanduzen Gas and Gasoline Engine Co., Cincinnati, O., write us:

For the past year our business has been all that could be expected of it. We have not been able to get an engine in stock since February last.

You will please notice by our letter head that we have moved from No. 25 Broadway to Nos. 202 to 208 E. Third street. The lot occupies the square between Third and Fourth streets in depth. The main building is 60x165 feet, three stories high. The other buildings are one-story for testing engines and erecting portable and traction engines, from which we anticipate an extensive sale this coming season, and from the way we are receiving orders for them at the present we feel as though we will have orders placed

for all we can build by June 1st. In conclusion, we will say that we feel it our duty to credit your valuable paper for no small amount of our success, and you may rest assured that our card will continue to appear in it, and if there is any change made it will be for more space.

N. P. Bowsher (Machinist and Millwright), South Bend, Ind., writes us:

During the past year I have put out a fair number of my balancing ways, and the bulk of these have gone into shops that have a national reputation. Everywhere the balancing ways are used they are regarded by the proprietors as being a capital investment, and the reports in general are gratifying to a degree. I have succeeded in effecting several improvements during the past year—among others the chilling and grinding of the top ways—and have made the changes without the necessity of increasing the price. The tools are as neatly and substantially gotten up as is possible to make them, and form a most creditable addition to any machine shop plant.

My business in the manufacture of rock maple mill cogs for filling shell or mortise gearing has been very good the past year, and I number many new patrons on my books. I make a specialty of the manufacture of mill cogs, and have special machinery and facilities for getting out work expeditiously and accurately.

Prentice Bros. (Machinists' Tools), Worcester, Mass., write us:

Our business for the year has been in excess of preceding ones. We are now planning for a new factory, to be built the coming year, as the present one is inadequate for our needs.

Orders continue to come in rapidly, and the outlook for the new year is favorable.

Worcester Machine Screw Co. (Set, Cap and Machine Screws and Studs), Worcester, Mass., write us:

Our business during the past year has been very good; in fact, considerably better than during the year 1891. We have increased our business somewhat, and have built an addition to our works of about 75x50 feet, two stories high, a part of which we use for a storehouse for iron and steel. The prospects for 1893 look very favorable to us. There has been no particular change in the prices, product or materials, during the past year.

Jones & Lamson Machine Co. (Screw Machines, Turret Lathes, etc.), Springfield, Vt., write us:

Agreeable to your request of the 10th, we take pleasure in making the following statements: This year has shown a strong increase in demand for our flat turret lathe—our output being fifty per cent. greater than that of 1891, which is largely due to the addition to our plant of new and improved machinery, as well as an increase in the number of help.

Regarding business of next year, we believe it will be good. We have recently purchased an adjoining plant, which gives us ample room for our intended enlargement and an increase of water power. We have also recently put on a night force, so that we are now running 21¼ hours per day, and we would say furthermore that November and December, particularly the latter, have shown an increase in the number of orders. We are consequently quite hopeful.

Brown & Sharpe Mfg. Co. (Machinery and Tools), Providence, R. I., write us:

The sales of our machine tools have been slightly greater in value in 1892 than in 1891. The number of hands employed at the commencement of the year was 727, and is now 920.

During the year we have erected a brick fire-proof pattern storehouse 164 feet 6 inches long by 56 feet wide, three stories, with compartments for storing sand and foundry supplies. We also have completed the foundations for an extension to our No. 1 building, 160 feet long by 51 feet wide, with wing 49x51 feet. To the pattern shop we have added an extension 32x43 feet, two stories, and in connection with this a shipping room for the foundry, 60x50 feet. In this building we have placed two three ton traveling cranes, and in the foundry a five-ton traveling crane. Forty one old machine tools have been taken out during the year, and thirty-three new ones added; also two Harrison Safety Boilers, of 134 H. P. each, have been put in.

Prospects of business during the coming season seem to us to be good.

The New Process Rawhide Co. (Gears, Washers, Rawhide-bound Mallets and Chisel Handles, etc.), Syracuse, N. Y., write us:

We are pleased to report that during the past year we have increased our facilities considerably for turning out goods, that we have largely increased our shipments for 1892 over 1891, and that the outlook for trade for 1893 is especially gratifying. We are pleased to add that the results which we have obtained from the "ad." in your paper have been most satisfactory.

Heber Wells (Pattern and Brand Letters and Printers' Materials), New York, writes us:

The sales during the summer months of 1892 were quite moderate, but the demand now is greater and up to the average of a good year. The prospects for 1893 are good. The above applies to pattern and brand letters for machinists.

The Brady Manufacturing Co. (Engineers and Contractors), Brooklyn, N. Y., write us:

We are "specialists," and have practically nothing but our "ability and experience" to offer *for a consideration*. It is not easy—or even possible—to say what our prospects are for the coming year. The last year has been above the average, and at present we are *very busy* fitting up several complete plants, with drawings, patterns, special tools, fixtures and gauges for the manufacture of specialties, on the interchangeable plan, working nearly one hundred hands, with plenty of new work in sight. We are entirely satisfied with the outlook.

John S Leng's Son & Co. (Importers of and Dealers in Iron and Steel, Weldless Steel Tube, Lever and Cam Valves, etc., etc.), New York, write us:

During the year now closing we find our business has increased. The use for our special weldless steel tubes is extending, and many new applications for them are coming to light. We have recently taken up the carrying of various parts for bycicles, as this fits in with our supply of tubes for that work. We look forward to a good and more extensive trade for 1893.

Crescent Steel Co., No. 480 Pearl street, New York, write us:

Replying to your inquiry as to business during the past year, we have to say that it is fully up to the average, with a decided increase in the consumption of the finer grades of steel.

There has, however, been extraordinary pressure for lower prices, and a desire on the part of some consumers to use cheaper qualities of steel for tools than were in demand formerly. With the sharp competition in finished tools and hardware, comes a rigid scrutiny of costs, and reduction in some quarters beyond a point of economy. We have always urged the advantage of a fine quality of steel for tools that do continuous hard work, and experience has fully supported this position.

No amount of talking will make a tool or die wear longer than the quality of stock it is made from, together with skillful treatment, can stand, and in the prospect for future business must be considered the fact that, where machine tools are run faster and required to do more work, a better, and not a poorer quality of stock will have to be used, and more care and time taken in its treatment. Some departments of our works have been very full of orders, and others at times not quite so rushed.

Our methods of production vary but little, our efforts being to steadily improve our output wherever possible, and to this end we have long time contracts for such quantities of the finest irons known to steel makers as will provide our customers with steel peculiarly well adapted to their wants, and up to the highest work expected. The use of such high-grade material does not permit reduction in prices, and our efforts will be towards furnishing better steel all the time, even if it is to be done at a higher cost. There is a market for it and we do not doubt that we will get our share of the business.

E. W. Bliss Co. Limited (Presses, Dies and Special Machinery), Brooklyn, N. Y., write us:

The last twelve months have witnessed by far the greatest enlargement and most extensive improvements in our works which have taken place during the history of our concern.

After amalgamating with our business that of The Stiles & Parker Press Company we decided to move their entire plant to our Brooklyn works. Partly to accommodate the increase of our business in that direction we put up an additional building 150 feet long by 90 feet wide and six stories high.

Our machine shops now occupy the entire block bounded by Adams, John, Pearl and Plymouth streets, and inclose in the center an erecting shop for heavy machinery spanned by a twenty-five ton electric traveling crane.

We have put in a large number of new machine tools and are building some large boring and milling machines specially adapted for our peculiar requirements. Jigs and special devices for the rapid and accurate production of our standard machines are being put into use more extensively than ever.

We have also equipped a portion of our works with special machinery for the manufacture of Whitehead torpedoes and torpedo guns which we are making on contract for the United States Navy Department. We are about to deliver a number of these torpedoes to the government. The development of this branch of our business has called for much mechanical skill and elaborate investigations, not to speak of the large investment.

All our departments have been well filled with orders and we have not noticed any falling off even since the election.

The prospects are thoroughly good, and we expect to make further extensions of our facilities.

The Pratt & Whitney Co. (Machinists' Tools, Forging and Finishing Machinery for Sewing Machine and Gun Manufacture and Special Purposes), Hartford, Conn., write:

The value of shipments of The Pratt & Whitney Company during 1892 varies but little from that of 1889, and is about 10 per cent. less than the average for the three years 1889–91 inclusive; though, as prices have been somewhat lower during the past twelve months, the output has not been so much less as would appear from the consideration of values only. The year 1893 will open with between 800 and 900 names on the pay roll, the usual number of orders, and a fair prospect of business during the year.

There has been no change in the price of labor, and but little reduction in the cost of material. The substitution of special tools, turret head and milling machines for ordinary lathes and planers has brought about a reduction in the cost of machinery, and a consequent revision of prices which favors the buyer. A new price list is now ready for distribution.

Valley Machine Company (Key-seating and Rack cutting Machinery), Saginaw, E. S., Mich., write us:

This has been an exceptional year for us, both in our general machine line and key-seater. Not a month has passed that we have not received several orders, and one month we received orders for eight key-seaters. Our shop is full of work, and we are working more hands than ever before—our only trouble is in getting competent mechanics.

We are adding to our plant all the time, and expect to put in several new tools after the first of the year.

The outlook for 1893 is first rate, as we have orders enough at present to carry us well into the year.

Betts Machine Co. (Metal-working Machine Tools for Railway, Bridge and Machine Shops and Iron Works generally), Wilmington, Del., write us:

The condition of business for the greater portion of the year just closed may be said to have been fair.

After the 8th of November the bottom dropped out, and now there is little or nothing doing

We have added no new buildings to our works, and do not contemplate any additions now.

Skilled labor remains as high as we ever have known it, and all indications point to reductions in the near future.

The prospects for the new year, as we see them, are not at all encouraging.

S. A. Smith (Manufacturers' Agent), Chicago, Ill., writes us:

Trade for the past year has been very good, especially the first part. The last half has been very intermittent. The tendency of prices has been very seriously downward and still continues. Buyers are very conservative the uncertainty of the political situation casting a shadow over the otherwise good prospects for '93. A large portion of the business community are in doubt as to what new theories of political economy will be put in practice, and that has a tendency to inaugurate a waiting policy. We hope they will get over it soon, and we shall all do what we can to make '93 a good year.

Cleveland Twist Drill Co. (Drills, Drill Sockets, Reamers, etc.), Cleveland, Ohio, write us:

Our business for 1892 has been very satisfactory to us indeed. Prices on our goods have dropped a little during the year, but not as much as in previous years. Sharp competition among the different manufacturers has resulted in squeezing prices down to about cost, and we are looking for an improvement in this respect. The volume of business for 1892 has been very much larger than last year, and we have been crowded all the time with orders, particularly in our reamer department. We have been so pushed to fill orders that we could not accumulate any stock on hand at all, but we have just added new grinding machinery, which we hope will put us in shape to get ahead of our orders on this class of work in a few months.

The building which we erected a year ago is now full of machinery to its utmost capacity, and if our business grows, as we hope it will, we will soon be obliged to build another addition. We see no reason why 1893 should not be a good business year. We are not anticipating any boom in our line, but see no reason why we should not have a steady demand for our goods.

The Cincinnati Milling Machine Co. (Machine Tools), Cincinnati, Ohio, write us:

We are well satisfied with the results of last year. Business has been good all year around, our sales having been very much increased over those of the year previous. During the year we brought out a small universal milling machine and one large heavy plain milling machine, which have been favorably received by the trade. Our facilities for manufacturing have been largely increased. Our agents all speak very encouragingly, and we are looking forward to 1893 for still better results.

Acme Machinery Company (Bolt, Nut and Special Machinery), Cleveland, Ohio, write us:

We have done a good average business during the year just closing, and employed our usual force of men.

In addition to the large and increasing sales of our Acme bolt cutters and nut tappers, we also sold a large number of our new bolt-heading and forging machines, of which we now build a full line and for which demand increases as those machines become better known.

We have added a few more machine tools again during the year and also equipped our shop with an automatic fire sprinkler system.

The prospects for business for the coming year we consider quite good. Cost of labor and material practically unchanged.

The Hendey Machine Co. (Machine Tools), Torrington, Conn., write us:

Our business for the year has been a little in excess of the previous year, but prices have been lower, and the margin of profit is very small.

We have run full time throughout the year, and with a full number of hands, and wages are fully as high as at any previous time.

We have during the year sold off all the lathes in use of other makes than our own, and have replaced them with lathes of our own make. Also a number of other tools. We have also added a few special tools to our plant.

We have completed and are now occupying our new office building, and find it convenient and pleasant, and a help in our business.

The upper floor we use as a drafting room, with a fire-proof vault on each floor, the upper one for our drawings.

During the year we have built a large amount of special work — a suspension shaper, and a traverse shaper of large size for switch and rail work—and we now have in hand what will, no doubt, be the largest shaper ever built in this country, having a cutting stroke of 72", and will weigh over 30,000 pounds.

We are now at work, and will shortly have ready for the market, the Norton patent screw cutting lathe, which you illustrated in your paper during the early part of the year, March 24, No. 12, and which we think will be the finest thing of the kind ever brought out.

We consider the prospect for business the coming year to be good, as we will start off with a large amount of work on hand, and with the improvements we will bring out soon we expect to have a fair share of trade throughout the year.

Penberthy Injector Co. (Penberthy Improved Automatic Injector), Detroit, Mich., write us:

Our business during the past 12 months has been very much in excess of any previous year's business. During the summer, notwithstanding the fact that we had nearly doubled the number of lathes in our shop, we were unable to keep up with orders, and during the past six weeks, which we usually consider our dull season, our factory has been running on full time, and still we have not accumulated any stock.

Our prospects for the coming season of 1893 are very bright. We have orders already on our books from traction engine manufacturers and others to the extent of between 3,000 and 4,000 injectors, and orders are still coming in. Our present factory now being taxed to its utmost capacity, we

have decided to enlarge the same, and work will be commenced during the present week on an addition which, with some remodeling of the present factory, will give us a three-story factory, 100x130 feet, and will enable us to more than double our present output during 1893. In regard to price, would say that while, of course, with the increased output we have been able to slightly lessen the cost of manufacture, yet increased competition has reduced prices to the point that profits remain about the same.

Frick Company (Eclipse Machinery, Corliss Steam Engines, Ice Making and Refrigerating Machines, Steam Boilers, etc.), Waynesboro, Pa., write us:

Prospects of business, judging from the accumulation of orders during the past sixty days, are very good for 1893.

During the year just past we have built a second erecting shop, which has been fitted with improved facilities for handling machinery. Prices of labor unchanged.

Market price of products, owing to severe competition, is not as satisfactory as it should be. Materials purchased at about the same rate.

New Doty Manufacturing Co. (Hand and Belt-power Punching and Shearing Machines), Janesville, Wis., write us:

Our business during 1892 has been about 20 per cent. larger than during 1891. Prices have been about the same. There has been no difference with us in the price of labor. We have made some improvements in the method of manufacture, chiefly in the line of simplifying our machines. We have so changed our patterns as to cast solidly with the body of machines many pieces that we formerly bolted on.

In this way we have done away with many joints and bolts. We have put in a number of new tools during the year, among them a large planer and a large radial drill of our own make.

We have no definite opinion as to prospects for business in 1893. At present business is a little slack, owing partly, we think, to the unsettlement caused by a presidential election.

We are now preparing a new catalogue of our machines, and in other ways are getting ready to go after our share of trade for the coming year. We are inclined to think that machine tool builders are among the first to feel any change for the better or for the worse in the general business condition of the country. If such is the case they must be deeply interested in the future tariff legislation of President Cleveland's administration. Would it not be interesting to read the opinions of prominent machine tool builders as to the effect of tariff legislation on the machine tool business? Now that election is over such opinions would be free of the charge of political bias.

W. D. Forbes & Co. (Engineers), Hoboken, N. J., write us:

The passing year has seen considerable improvement in our business; at the present writing there is more work in sight by a great deal than there was at this time last year. The work we have in hand is also more than we had in the previous year. We cannot find a single thing, as far as work goes, to complain of in the past, and we certainly think that the outlook for the coming year is to us brighter.

We are employing more men than we did twelve months ago, and the refinements of some specialties undertaken at that time are about done, and we hope soon to place our articles before the public through your columns.

S. S. Townsend, General Agent for the P. H. & F. M. Roots' Co (Rotary Blowers, Gas Exhausters, Portable Forges, etc), New York, writes us:

We beg to state that the year just closing has been an exceptionally prosperous one for the Roots blowers. While our sales of small machines for regular line of work have been fully up to any previous year, this year has exceeded all others in the number of large machines, particularly for special lines of work, such as pneumatics. We can safely say that the Roots blower stands at the top to day, and, as we are aiming constantly to improve it and reaching out for new applications for our machines, we confidently expect to remain at the top.

New Haven Manufacturing Company (Machine Tools), New Haven, Conn., write us:

While our business for 1892 has been very fair as to the quantity of work we have turned out, at the same time the prices obtained have been low, so that the general result we presume will be less favorable than in some other recent years. However, we consider that we have no reason to complain, having kept our full force employed at full time throughout the year, and the outlook for the coming year we think is very good indeed. We have during the past year added a good many new tools to our plant, and propose to do still more in the coming year, and also to continue the new designs and patterns to our machines, some of which are already in the market. In reference to the matter of changes in prices of labor and materials, we find the price of material of all kinds quite low, but cannot note any change in the prices paid for labor, and whatever tendency there may be in this direction seems in the way of higher prices.

J. A. Fay & Co. (Wood-working Machinery), Cincinnati, O., write us;

Our shipments for the year just closing have not been quite as large as they were the year previous. They have been sufficiently great, however, so that we have been enabled to employ the greater portion of our force ten hours per day. We have added fifteen new machines to our list of wood working tools; we have also completed our improvements on the two large buildings purchased last year, and our facilities for handling complete outfits and shipping by car-load are perfected, and we have found these improvements of very great benefit.

Wages are about the same as last year; material has declined somewhat and prices have been reduced accordingly. During the past two weeks we have been overwhelmed with orders and have received a large number of what seem to be very good inquiries.

Norton Emery Wheel Co. (Emery Wheels and Emery Grinding Machinery), Worcester, Mass., write us:

We are pleased to state that the year just closing is the most prosperous since our organization. We have done a larger business than ever before, collections have been good, and we feel very well satisfied. We see nothing to indicate up to the present time but what the prospects for next year are first-class.

Bardons & Oliver (Machine Tools and Special Machinery), Cleveland, O., write us:

We would say that we finished our first year the 1st of October last, and were satisfied with the result.

Orders have come in rapidly the past two months and we now have all the December and January delivery promised that we can fill.

Business outlook to us seems good.

Joseph Dixon Crucible Company (Miners, Importers and Manufacturers of Graphite, Plumbago, Black lead Crucibles, Pencils and other Graphite specialties), Jersey City, N. J., write us:

The year of our Lord 1892 has suited the Dixon Company to the queen's taste. Competition, it is true, has been sharper than ever, but that has spurred us to greater efforts. Prices all along the line have more or less fallen, but that has compelled us to seek, and, in some instances, to find lower cost of production, and such reductions as we have found have not been taken out of wages. If anything, wages have been increased and not decreased. Our total sales have increased a fair percentage, and as a consequence we have had to make liberal additions to our already large plant, and the Dixon Company stands before the business community to-day with a unique plant. There is nothing like it in the world.

Everything that is in use in the arts that is made of graphite is made here under one roof and under one management, and on a scale different, both larger and wider and in a more improved way, than it is made elsewhere in any city at home or abroad. The outlook for business for 1893 is good.

The Long & Allstatter Co (Power Punches, Shears and Agricultural Implements), Hamilton, O., write us:

We report enlargement of our works about 25 per cent. in capacity during the year 1892, and are now putting in a large electric traveling crane 47 feet span. In the near future we expect to run our entire works by electric motors suitably distributed over our works. Prospects for 1893 considered fair. Business satisfactory the past year, and we have brought out a considerable number of new tools, especially those for punching a large number of holes at one operation.

The Meriden Machine Tool Co (Machine Tools and Brass-working Machinery), Meriden, Conn., write us:

In reply to yours of 10th, we are pleased to report satisfactory progress during 1892. In the early part of the year we moved into our new factory, so that we now have ample room and much better facilities than before for carrying on our business. The location is also more favorable to friends who call, it being directly on the line of street cars. We took advantage of the dullness which we, in common with many others, experienced during the summer, to adapt our forming lathe to turning brass, etc., as well as britannia and other sotter metals for which it had been mostly used, and to bring out a machine for winding silk on handle bars for caskets, this being directly in our line, as much of our trade is with manufacturers of casket hardware. We have been for the last three months driven on orders for our perfected brass forming lathes to the extent that we have been obliged to run evenings considerable of the time, and with orders yet unfilled and inquiries coming in well, so that we cannot see but that our prospects are good for the coming year.

Cooke & Company (Engines Boilers, Machine Tools, Shafting, Hangers, Pulleys and General Supplies), New York, write us:

1892 has been fully up to our expectations, and shows a satisfactory progress in our business, particularly in the lines which we have been working as specialties. Each year, however, brings keener competition, and requires more hustling than the last.

What another year may bring requires wiser heads than ours to predict, but we do not apprehend that any radical and sudden changes will be made in our national policy to the detriment of the manufacturing interests. There will no doubt be hesitation in many cases about making extensions and improvements, and building new plants, but this may not be an unmixed evil, and the "machinery man" who simply "saws wood" and advertises in the AMERICAN MACHINIST can face the future with equanimity.

Randolph Brandt (Selden Patent Packing, Mine, Mill and Steamship Supplies), New York, writes us:

Replying to your valued favor of the 10th: The large crops of 1891-92 I felt would result in a corresponding increase in demand for manufactured goods, and with that view I increased my facilities for manufacturing, advertising account, and put out extra salesmen; the results, I regret to say, have not justified these expenditures.

While unquestionably the Columbian Exposition will bring large numbers of people into the country with money to spend, and will be the means of putting into circulation a great deal of our own people's money, increasing railroad earnings and bringing buyers to the merchants' stores, I cannot see wherein the manufacturing interests will show any great improvements over those of 1892. Until the silver question and the tariff are definitely settled there is bound to be a tendency to go slow in new enterprises.

Montgomery & Co. (Tools, Supplies and Machinery), New York, write us:

Your favor duly received. In answer thereto we wish to state that 1892 has been very satisfactory to us. Our business for this year shows a large increase over any previous year, and we are well satisfied, and only hope that 1893 will pan out as well.

We have attributed considerable of the increase to our new catalogue, which we commenced distributing the latter part of April. We still have a few of them left, and will send them in accordance with our terms announced regularly in your paper.

We anticipate a large business for 1893, as we have secured some very valuable agencies in connection with our regular line. Our most valuable agency is that of Messrs. Grobet Freres—the makers of the world-renowned Swiss files—and as we intend keeping a very large stock of these goods we have every reason to believe that the sales on them for 1893 are going to be larger than ever before. Our hopes are great, and may the realization be greater.

Grant Anti-friction Ball Co. (Balls for All Anti-friction Purposes), Fitchburg, Mass., write us:

Yours of 10th to hand, and in reply will say: We send you a copy of our local paper, *Town Talk;* from this you will see the increase of our business by the extended notice. Prices on our goods remain the same as last year, and labor has had a slight upward tendency. Our outlook for business this year is very good, and many inquiries are coming from foreign countries. In regard to improved methods, we are constantly on the lookout for any improvements that will better and cheapen our goods, as our motto is, "The best obtainable in both stock and machinery."

Hetherington & Berner (Founders and Machinists, Hoisting and Veneer Machinery, Elevators, etc.), Indianapolis, Ind., write us:

Our business for the past year has, in the main, been evenly prosperous. The bulk of our trade has been in structural iron work and special patented machinery of various kinds. Towards the close of the year we decided to discontinue our boiler making branch of the business, for the reason that the manufacture of steam boilers has become a special line of business, and to successfully compete with current prices would call for the refitting of our works with special machinery. In addition to this, the trouble we have had with labor in that line during the past year has made the carrying on of that business more trouble than it was worth. We now have our boiler work done by contract elsewhere. The prospects for the ensuing year are that the trade will continue to be good, for some time at least.

Trump Bros. Machine Co. (Light Machinery, Finished Hexagon Nuts, Stud, Coupling and Tap Bolts), Wilmington, Del., write us:

The past year has been a satisfactory one, unprecedentedly so during the summer months, which are generally dull with us.

At this writing we are full of work, and the prospects are very encouraging; whether this pace will be maintained through the coming year is, of course, only a matter of conjecture.

We have not increased our buildings, but have added several new tools, among which we mention a 36" Lodge & Davis lathe, and several tools of our own design and construction.

We are busily engaged in making the special jigs and fixtures for manufacturing a new machine, which we expect to have on the market early in the coming year, and about which we will have more to say later.

Wages have advanced; material is about the same, while prices for our product in several lines have decreased, as compared with last year.

If our Democratic friends will give the tariff a fair chance in its present shape, we anticipate a great deal of business, otherwise we are afraid it will be anticipation without realization.

Nicholson File Company, Providence, R. I., write us:

Our sales for 1892 will show a marked increase over those of any previous year during our existence.

The absence of any speculative tendency is noticeable, orders in the main being for immediate requirements.

Prices have ruled very low and margins correspondingly small.

The outlook for a large business during 1893 was never better, were it not for the uncertainty in the minds of all consumers, middle men and manufacturers, as to possible adverse legislation by the incoming Congress.

The momentum which all mechanical industries have already obtained will, we think, warrant a good average business for the first half of '93.

Pancoast & Maule, Philadelphia, Pa., write us:

There has been a marked improvement in the volume of business with us during the past two months, and were the margins of profit commensurate, we would have small reason to complain.

Our new "skeleton pipe die," which we have been advertising in your columns, has leaped at once into favor, and orders are coming in for it from all quarters, including numerous inquiries from abroad. A "long felt want" (how strange and new that expression sounds) ever exists, at least in one form, viz., the want of every one for just a little more for his dollar than he has been getting, and this tool seems to be able to give him just that, viz., a pipe-threading tool of extreme endurance, which can be had at a very low figure. We are constantly improving our facilities for getting out the 'skeleton die," and have a number of new sizes under way, and we anticipate a heavy demand for this tool in the new year so close at hand, in the hope and firm conviction that our expectations will be realized.

The W. & S. Hydraulic Machinery Works (Hydraulic Machinery, Tools and Supplies), New York, write us:

We find that our anticipations, as stated in our last letter, have been realized so far as amount of work is concerned. We have been compelled to add quite a large amount of machinery of both special and regular makes, and the output has been very much larger than last year; also, the number of new machines and tools built by us has been more than any previous year, while almost all of our older machines have undergone more or less improvement. In our hydraulic jacks we are steadily improving the quality, intending to keep as far ahead as our ingenuity can keep us. We have at the present time a large amount of work in the shop. We have been too busy to make estimates upon the probabilities of next year's work.

Many letters stand over, to appear in a future issue.

"Keep's Test" for Cast-iron—I.

BY W. J. KEEP, DETROIT, MICH.

To ascertain whether cast-iron is suitable for a given purpose, its strength, shrinkage and chill must be determined.

The object of this paper is to advocate a standard test for cast-iron, that can be made expeditiously, and such that all tests may be compared with each other. The name of "Keep's Test" was proposed in the "Journal of the U. S. Association of Charcoal Iron Workers," in 1887. To give some idea of what has been revealed by its use, we refer to the papers mentioned in the foot-note at the bottom of this column.*

"KEEP'S TEST" consists of a definite routine pursued in using special appliances. The results are wholly *relative*, that is, greater or less than another test by the same method. When it is stated that an iron has a certain strength, shrinkage, etc., "Keep's

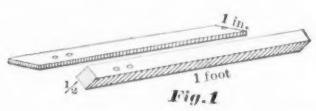


Fig. 1

test," each detail of the test by which the result has been reached will be known, and, knowing the maximum and minimum results already reached by other users of this test, we know the value of an iron by the *relative* position that the results take between the extremes referred to.

The value of any record of test depends upon the operator adhering absolutely to the routine followed by others using this test. When the routine has become familiar, it will be found to be the natural way to proceed. After the castings of test bars have been made, an ordinary test can be completed in about half an hour.

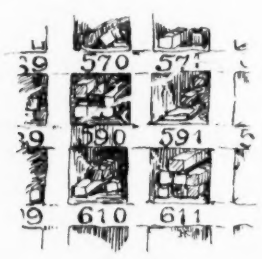


Fig. 2.

THE SIZE OF TEST BARS.—The size and shape of the test bar is of the greatest importance. As all results are *relative*, any size of bars might have been adopted; but we have decided upon a pair of bars cast together for gray iron, one of them $\frac{1}{2}$x$\frac{1}{2}$x12 inches and the other 1x$\frac{1}{10}$x12 inches.

We have found that the half-inch square bar will show the peculiarities of irons ranging from dark gray to white better than any other size, and will reveal the influence exerted by very slight changes in chemical composition, on account of sulphur in the fuel or from change of mixture.

The thin bar (1x$\frac{1}{10}$x12 inches) is more sensitive than the square bar. Any variation in the size or shape of a casting will change the grain of the iron, therefore no change must be made in the sizes of the bars or the method of gating.

The larger a casting the coarser the grain, and such coarseness will lessen the strength per unit of section. The founder, therefore, having ascertained the relative strength of an iron, or of a mixture of irons, by "Keep's test," can, by a little experience, tell what it will be in a larger or in a smaller casting. Owing to the small size of these bars they can be made very nearly the exact size of the pattern, are convenient to handle, and all bars of a test can be preserved in a pigeonhole 2$\frac{1}{2}$ inches square and 12 inches deep (Fig. 2).

It is often desirable to test a small quantity of iron, and, with 12 pounds of metal,

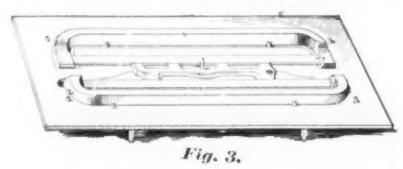


Fig. 3.

six pairs of test bars can be made. For scientific work this is a great advantage.

In this country a common form of test bar is 1x1x12 inches; and in foreign countries a bar two inches high, one inch wide and two feet long is more common. Even the one-inch square bars cool so slowly that any slight variation in constitution is not likely to be apparent. The argument that the larger bars more nearly represent the metal of heavy castings is valid, but castings are never made of the dimensions of any test bar, and any variation vitiates the comparison.

It is, therefore, so far as this reason goes, as well to use one shape or size of test bar as another, and then reason out from experience what will be the effect of change of shape or size. A test of a single bar is of little value, as bars of the same size, and from the same ladle of iron, will show quite

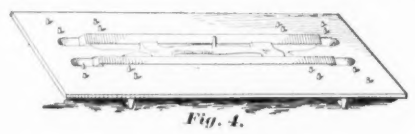


Fig. 4.

a variation. The more bars the better, and by the use of half-inch bars an average of four or six bars can easily be obtained.

PATTERNS.—These are made of bronze, and from one original set, to insure uniformity. They consist of an iron follow board (Fig. 3), with gated patterns of a square and a flat bar. Accompanying these are four pairs of yokes, as seen in Figs. 3, 7 and 15. These have parallel chilling surfaces 12$\frac{1}{2}$ inches apart, the ends of the bars running against these surfaces when poured. For those who wish more square bars, or use irons where the thin bar would always run white, a follow board (Fig. 4) containing patterns for two square bars and yokes to fit

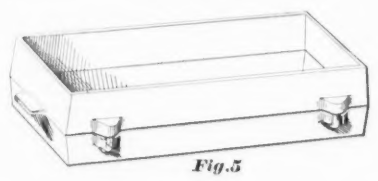


Fig. 5

them is furnished. Four iron flasks, Fig. 5, accompany the pattern, to insure the bars being duplicates of the patterns.

MOLDING.—The molds can be made by an ordinary bench molder in whom has been carefully impressed the necessity for always doing his work in exactly the same way, and who, once he has become thoroughly impressed with this idea, should be exclusively

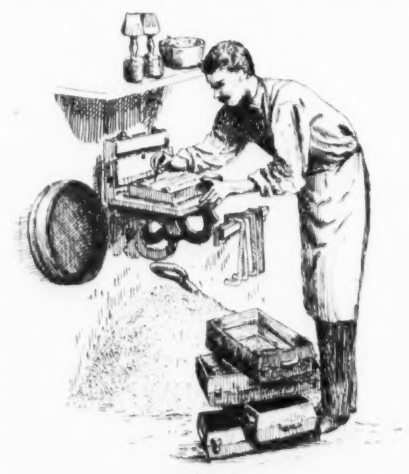


Fig. 6.

intrusted with this work, and made to appreciate its importance. He must use green sand of at least as good a grade as what is known as "No. 1 Albany," that has been tempered as for ordinary work, only rather dry, and which contains no sea coal.

Fig. 6 is a view of the molding bench in our testing room. The follow board is placed so that the square bar is towards the molder. He places No. 1 yokes upon it, after having moistened the chilling surfaces with a cloth on which is a little kerosene oil, to prevent rusting. A few casts without oil would ruin the surfaces, and the ends of the test bars would also be imperfect, but with oil the yokes will last for years, and the ends of

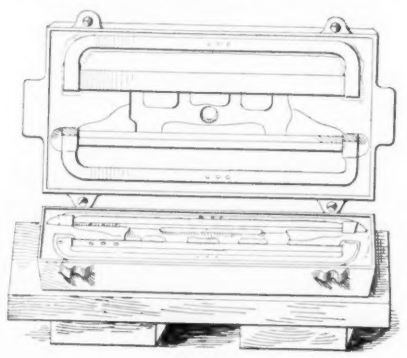


Fig. 7

the bars will be sharp and smooth. The pattern being placed in position between the yokes, the mold is made in the usual way, but the patterns must *never* be rapped. When the mold is rolled over and opened the patterns must be drawn so as to leave the mold the same size as the pattern. No facing is used, and no slicking is done to the body of the mold. The mold of the square bar is now away from the molder (Fig. 7). With the sharp end of his slick he presses in the sand exactly the number of dots that he sees on the yokes. This number will *always* be on the farther side towards the *left*-hand end of the mold of the square bar, and on the left end of the flat bar. If two square bars are in the mold the dots on the

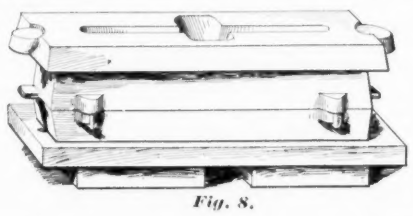


Fig. 8.

near bar *must* be on the side towards the molder, and at the *right end*. The reason for this location of the numbers is to insure the proper location of the bars in other parts of the test. Have all marks at one end of the bar, and leave the center of the bar smooth. Some sand will have worked in between the pattern and the chilling surface. This is removed with the slick. The parts of the flask are held together by ordinary bench molders' weights (Fig. 8). When the molds are all completed the number on

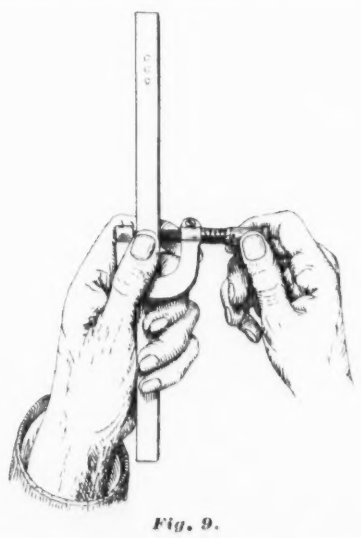


Fig. 9.

each flask will indicate the number on the yokes in each mold. They are to be placed for pouring in the order of their numbers.

The iron should be caught each day at the *middle* of the heat, so as to represent the average iron.

That at the first part of the heat will be harder and weaker, from the influence of the fuel, and from the cupola being cold, while the iron at the end of the heat will be softer and stronger, from the furnace being hot. When through, wipe the sand and moisture from the yokes, and oil the chilling surfaces. Let the molder understand that each time before he places the yokes on the follow board, and after he is through with them, he is to oil the surfaces.

Fig. 10

The average molder should be followed through the first set of molds step by step from start to finish, after which he will have no difficulty.

Rap the sand from the bars, break off the gates and tie the bars together, and attach a tag containing date and other necessary data. It is necessary to prepare this tag and give it to the molder, and particularly so if more than one cast is to be made in one day.

The molder will carry follow board yokes and bars to the testing room.

PREPARING THE BARS.—Clean the sand from the bars, grind off the marks of the gates on an emery wheel, and grind the numbers nearly off, so as to leave flat bright spots. Hold the flat sides of the ends of the bars against the wheel, so as to make the edges of the ends sharp, but *do not, in any case*, let the bar slip so as to *touch the end*

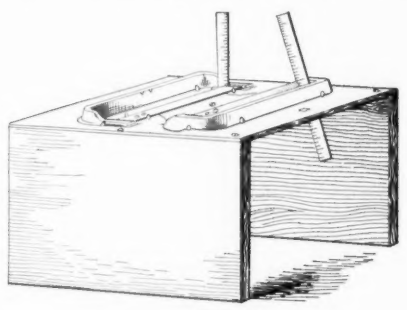


Fig. 11

surfaces of the bar to the wheel, nor do any smoothing up on the sides of the bar with the wheel, except at the ends. Take a worn-out file and rub each chilled surface of all bars, to remove the slight fin that has been turned by the wheel. The surfaces being chilled will not be injured by the file. With the same file rub or draw-file the four sides at the center of the bar clean, but not bright. Leave the yokes and the bars together over night, or until they are of the same temperature. Never open the package of more than one set of bars at one time, and, as soon as prepared, tie up and put on the tag.

DIMENSIONS OF TEST BARS.—Take each square bar, Fig. 9, and hold the number on

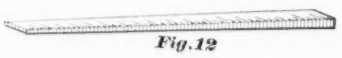


Fig. 12

top, and the gate marks at the bottom, and measure with a micrometer caliper the horizontal thickness of the bar. This is the *height* of the bar, and the other dimension is the *breadth* (see Fig. 10).

These measures are recorded for each test bar for future reference, and to see that the molder does not become careless. Each bar will vary sometimes from 5 to 10 one-thousandths of an inch, but this slight difference will not influence the result nearly as much as the variation in structure of each bar.

They may all be considered as half-inch bars.

For convenience, cut a hole in the case containing the caliper, so that the measure of 500 may be left open.

SHRINKAGE.—The chief use of the yokes is to provide a means for measuring shrinkage.

In filling the molds, the iron runs against the chilling walls of the yokes (Figs. 7 and 15), so that the ends of the bars are perfectly square, and when the metal is liquid, the bars are 12$\frac{1}{2}$ inches long. As the metal solidifies and cools, the ends draw away from the chilling surfaces of the yokes.

The measuring table (Fig. 11) is an exact counterpart of the follow board, with openings through it at both ends of each bar. The bars and yokes of the same number are placed upon this table so that they will lie exactly as they did in the mold.

The shrinkage is measured with a graduated steel wedge or gauge (Fig. 12). Each

* Notes on "American Foundry Iron," South Staffordshire Institute of Iron and Steel Works Managers, 1888. "Physical Tests for Cast-iron," Journal of U. S. Association of Charcoal Iron Workers, 1887. "Influence of Aluminum upon Cast-iron," Trans. Am. Ass'n for the Advancement of Science, 1888. "Ferro Silicon, and the Economy of its Use," Transactions American Institute of Mining Engineers, vol. xvii, p. 253, 1888. "Silicon in Cast-iron," *ibid.*, vol. xvii, p. 683, 1889. "Aluminum in Cast-iron," *ibid.*, vol. xviii, p. 102, 1889. "Phosphorus in Cast-iron," *ibid.*, vol. xviii, p. 459, 1889. "Aluminum and Other Metals Compared," *ibid*, vol xviii, p. 798, 1890. "Aluminum in Wrought-iron and Steel Castings, *ibid.*, vol. xviii, p. 835, 1890. "Aluminum in Carbonized Iron," Journal of the Iron and Steel Institute (London), vol. i, 1890. "Manganese in Cast-iron," Trans. Am. Inst. M. E., vol. xx, p. 291, 1891. "Silicon in Foundry Mixtures," *The Iron Age*, June 9; the AMERICAN MACHINIST, June 16, 1892.

graduation marks one thousandth of an inch in thickness of the gauge, and it measures from $\frac{100}{1000}$ at the thin end to $\frac{200}{1000}$ at the thick end, which will measure the shrinkage of all gray iron. A gauge is also made from $\frac{200}{1000}$ to $\frac{300}{1000}$ for white cast-iron and metals with a greater shrinkage than iron, and another from $\frac{50}{1000}$ to $\frac{100}{1000}$ for metals with shrinkage less than iron.

Take No. 1 bars and yokes, the square bar towards you and the gate marks on the inside edge (see Figs. 11, 13 and 14). Shove the square bar to the right against the yoke and pass the measuring gauge down between the bar and the yoke, at the left end at the upper corner of the square bar, having the graduated edge away from you. Let the wedge go as far down as it will of its own

Fig. 13.

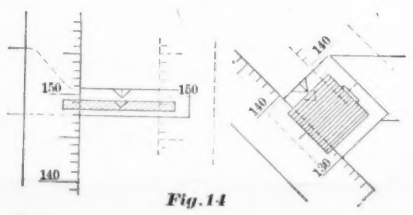


Fig. 14

weight, and read the graduation that corresponds with the upper edge of the bar; keep this reading in mind, withdraw the gauge, shove the bar to the left, enter the gauge on the right end and read the marking.

Record the average of the two readings 1 and 2 (Fig. 15), as the shrinkage of the cold edge of the bar. Now turn the gauge with its graduated edge towards you, and get the average of the two readings 3 and 4 of the inner or hot edge of the square bar and record it. Now carry the gauge in the same position over to the farther side of the thin bar and record the average 5 and 6 of the cold edge, then 7 and 8 of the hot edge of the thin bar. This record is shown in Figs. 20 and 29 [to be published next week]. Re-

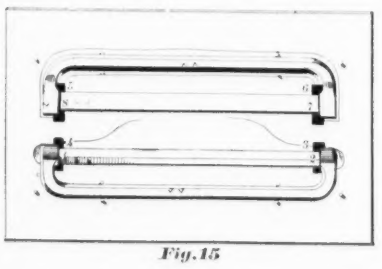


Fig. 15

move the No. 1 yokes and test bars, substitute No. 2 and measure the shrinkage as before, and so on with all numbers. Foot up the average of each of the four columns. Take the mean of the averages of the hot and cold edges of the square bar for the *shrinkage of the iron*. A comparison of the shrinkage of the square and thin bar will show many peculiarities of the metal. Whenever we speak of the shrinkage of an iron "Keep's test" we know that it is the average of at least four readings of as many ½-inch square bars one foot long.

The reason for always using the same yokes in which the bars were cast is that no two yokes are exactly alike, and there is a slight wear as their use continues. As all results are relative, a few are given. The lowest shrinkage noted for gray cast-iron was .105. The best shrinkage for stove castings is from .120 to .130 (silicon would be about 2.75). .175 to .150 is more usual in machine castings, showing silicon from 1.50 to 2.00 per cent. White iron has a shrinkage of from .200 to .260, according to silicon present. Wrought-iron melted and cast in a bar had a shrinkage of .292. Cast crucible steel with *C.* 1.52 was .255. A 16 per cent. ferro-silicon had a shrinkage of .315. The shrinkage of lead was .113, tin .053, antimony .068, zinc .148, copper .248, aluminum .166 to .191, alloys lead and tin equal parts (soft solder) .047, lead and antimony (common type metal) .064, common brass .190, bronze .177.

STRENGTH.—In searching for a short name that shall indicate a stress applied transversely at the center of a test bar and gradually increased until the bar is fractured, and also to distinguish between this and a fracture caused by blows, each greater than the preceding, at the center of the bar, it has been difficult to find or invent a short word that will describe this and only this stress. We have decided to use the expression dead load for this application of stress. In previous papers we have used the word "weight" to represent this stress, and in consulting such papers this change in terms should be kept in mind.

Standard Keys.

BY "CHIP."

Is there any probability, Mr. Editor, of our having a system of standard keys for shafting?

Shaft keys seem to be in about the same condition that screws were before they were standardized—every shop has its own system, or lack of system, as the case may be, and the sizes of keys in one shop rarely agree with those of another, although if we examine them they will be found to vary but little.

I was talking with Birchall about this last week, and he said there was really no reason why keys should not be made to a universal standard, which might be based on the diameter of shaft in obtaining the proportions of width and thickness.

"Of course," said Birchall, "all keys fitted to a shaft of given diameter are not supposed to do the same amount of work; in the transmission of power, two purposes are required of keys—either they are to transmit all the power delivered to the shaft, as in the case where they are used to secure a fly-wheel to an engine shaft, or they are to transmit a portion only, as seen in the numerous pulleys on a line shaft.

"As far as the force transmitted is concerned, we could find the shearing strain in each case, and make keys proportionate. This method would necessitate a knowledge of the forces to which the key would be subjected, and the conditions under which the shaft would be run; moreover, the same diameter of shaft might have a dozen different sized keyways.

"The method of calculating size of key from the strain it is to sustain is all right for such work as machine tools, where the nature and shape of shafts and arbors will allow different sized keys, but for general shafting, pulleys and couplings, it would evidently be more convenient and more reasonable to decide on some suitable size of key for a given shaft, and then make all keys to this standard, assuming that the key would be sufficiently large to transmit any force to which the shaft might be subjected.

"This is just what every shop has done; the trouble is, though, that no two shops agree as to what are suitable dimensions."

"A number of years ago," continued Birchall, "I decided to adopt some standard sizes in the shop, and looked up the matter of shaft keys pretty thoroughly.

"The rules for proportioning keys were numerous, and I found a great many systems in use. The thickness of key, and hence the depth of spline in shaft, was greater in many cases than I think is required; for an ordinary flat key not sunk into the shaft at all, but fitted to a flat filed on the shaft, will hold, with a good driving fit top and bottom, almost as well as a key sunk into the shaft, although the latter is more reliable. On the other hand, keys often appear to be too thin to drive well, though they may hold all right when driven home. A common mistake is to use a thin key as a feather. Feathers should fit well on the sides, and, preferably, should not touch on the top. To insure a good fit and prevent a feather key from rocking, it is evident that it must have a depth greater than would be required for a drive fit top and bottom.

"In determining the size of keys, some shops use this rule:

"'Make the width of key equal to one-fourth the diameter of shaft, and the thickness of key equal to half the breadth,' the taper varying in different shops from ⅛ inch per foot to 1 inch per foot.

"A similar rule to this, which, however, gives a wider key, is to add ⅛ inch to one-fourth the diameter of shaft to obtain breadth of key, the thickness being, as before, equal to half the breadth.

"Others make the breadth equal to one-fourth the diameter of shaft, and the thickness equal to one-ninth the diameter of shaft.

"Expressed as formulas these rules become:

$$\text{Breadth of key} = \frac{\text{dia. of shaft}}{4}.$$

$$\text{Thickness of key} = \frac{\text{dia. of shaft}}{8};$$

and in the second case:

$$\text{Breadth of key} = \frac{\text{dia. of shaft}}{4} + \tfrac{1}{8}''.$$

$$\text{Thickness of key} = \frac{\text{dia. of shaft}}{8} + \tfrac{1}{16}''.$$

"In like manner the third rule would give:

$$\text{Breadth of key} = \frac{\text{dia. of shaft}}{4}.$$

$$\text{Thickness of key} = \frac{\text{dia. of shaft}}{9}.$$

"Another rule is to make the breadth of key equal to one-fourth the diameter of shaft, and the thickness is determined by the diagonal of a parallelogram drawn at an angle of 30°, as shown in Fig 1. This is equivalent to multiplying the breadth of key by 0.58.

"A rule which I am informed is used a good deal in Germany is to add $\frac{3}{16}$ inch to one-fifth the diameter of shaft in order to obtain the breadth of key; the thickness of key being equal to one-tenth the diameter of shaft plus $\frac{3}{16}$ inch; the taper equals one-eighth inch per foot.

"Expressed as a formula this rule becomes:

$$\text{Breadth of key} = \frac{\text{dia. of shaft}}{5} + \tfrac{3}{16}''.$$

$$\text{Thickness of key} = \frac{\text{dia. of shaft}}{10} + \tfrac{3}{16}''.$$

"For shafts over two inches in diameter this rule gives sizes which agree very well with those obtained by the method of drawing a diagonal at 30°.

"All of these rules, if adhered to strictly, would give inconvenient sizes for general shop use, so we find that the actual dimensions of keys are generally made in sixteenths, although the thickness is frequently found to vary by thirty-seconds."

Here Birchall showed me some notes and tables of standard keys that he had picked up from shop foremen and others, showing shop practice in different lines of work.

I noticed that Brown uses the following table of sizes in his work—heavy machinery—but I think that for drive keys the thickness of key is excessive, thus weakening the shaft more than is necessary.

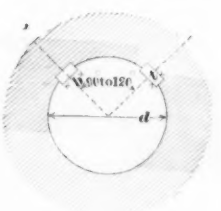
TABLE I.—BROWN'S DIMENSIONS OF SHAFT KEYS.

Diameter of Shaft.	Width of Key.	Thickness of Key at Thick End.
¾″ to 1⅝″	5/16″	¼″
1″ " 1⅜″	3/8	5/16
1¼ " 1⅝	7/16	11/32
1⅜ " 1¾	½	3/8
1½ " 2⅛	9/16	13/32
2″ " 2⅜	5/8	7/16
2⅛ " 2⅝	11/16	15/32
2⅜ " 3⅛	¾	½
3¼ " 3½	13/16	17/32
3⅝ " 4⅛	⅞	9/16
4 " 4⅜	15/16	19/32
4½ " 5⅛	1″	5/8
5 " 6⅛	1⅛	¾
6½ " 8	1⅜	1¼

Make taper of keys ¼ inch per foot.

The second table gives the sizes adopted by Thomson thirty years ago, which have been the standard in his work—general machine tools—ever since. These proportions are used for both drive and feather keys, and correspond closely to the rule: The breadth of a key is equal to three-sixteenths of the shaft diameter plus one sixteenth inch, and the thickness is equal to five thirty-seconds of the diameter plus $\frac{1}{16}''$, or:

$$b = \frac{3\,d}{16} + \tfrac{1}{16}'', \text{ and } t = \tfrac{5}{32}\,d + \tfrac{1}{16}''.$$



$b = \frac{d}{6}$; $t = 0.6\ b$

Fig. 2.

Key used in Woodruff's System

Fig. 5.

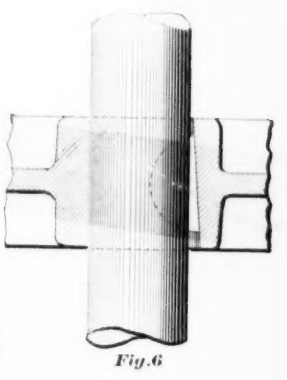


Fig. 6

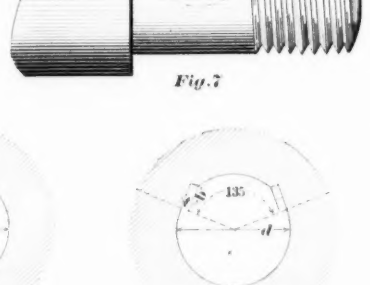
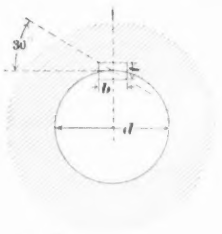
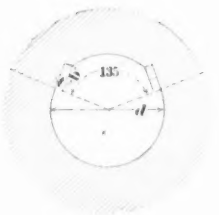


Fig. 7



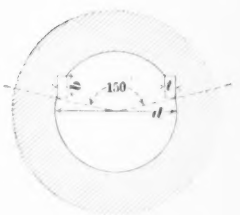
$b = \frac{d}{4}$;
t is determined as shown

Fig. 1.



$b = \frac{d}{8}$; $t = \frac{d}{16}$

Fig. 3.



$b = \frac{d}{6}$; $t = \frac{b}{2}$

Fig 4.

STANDARD KEY WAYS.

TABLE II. THOMSON'S STANDARD KEYS.

Diameter of Shaft.	Width of Key.	Thickness of Key.
⅝″ to 1⅞″	¼″	¼
1¼ " 1⅜	5/16	5/16
1⅜ " 1⅝	3/8	3/8
1¾ " 2⅛	7/16	3/8
2⅛ " 2⅜	½	7/16
2⅜ " 2⅞	9/16	½
2⅞ " 3⅛	5/8	9/16
3¼ " 3½	11/16	5/8
3⅝ " 3⅞	¾	11/16
3⅞ " 4⅛	13/16	¾
4¼ " 4⅜	⅞	¾
4½ " 4¾	15/16	13/16
4⅞ " 5⅛	1″	⅞
5¼ " 5⅜	1 1/16	⅞
5½ " 5¾	1⅛	15/16
5⅞ " 6	1 3/16	1

Table III (page 6) gives the sizes of keys as used by Lisal —— pulleys and shafting:

It will be noticed that the width of key for a given diameter of shaft is more nearly alike in these tables, but the thickness varies quite a little.

When Sir Joseph Whitworth standardized screws in England, fifty years ago, it is said that he took all the various angles of thread

which were to be found in use at the time, then, adding them together and dividing by the number of systems employed, he obtained 55° and called this angle the standard for screw threads. By this method he gave no one system the preference, but the sequel showed that in adopting a round top and bottom for the thread he practically shut out his competitors, as his own firm was best equipped to make taps and dies of the rounded top and bottom form.

Birchall's method of obtaining a standard for shaft keys was similar to that of Whitworth in determining the angle of thread; he obtained the average of all sizes which he could find, and called these averages his standard.

TABLE III.—LISAL'S DIMENSIONS OF SHAFT KEYS.

Diameter of Shaft.	Width of Keyseat.	Thickness of Key.
¾″ to 1 1/16″	1/4″	3/16″
1 1/8 " 1 3/8	5/16	1/4
1 7/16 " 1 5/8	3/8	5/16
1 11/16 " 2 3/8	1/2	3/8
2 7/16 " 2 7/8	5/8	1/2
2 15/16 " 3 1/4	3/4	5/8
3 5/16 " 3 3/4	7/8	3/4
3 7/8 " 4 1/4	1	7/8
4 3/8 " 4 3/4	1 1/8	1
4 7/8 " 5 1/8	1 1/4	1 1/8
5 1/4 " 5 5/8	1 3/8	1 1/4
5 3/4 " 6 1/8	1 5/8	1 3/8

Table IV gives dimensions thus obtained:

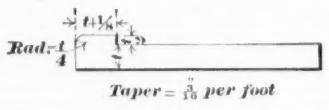
TABLE IV.—BIRCHALL'S STANDARD FOR SHAFT KEYS.

STANDARD KEYS.		
Diameter of Shaft.	Breadth of Key.	Thickness of Key.
¾″ to 1 1/16″	5/16″	3/16″
1 1/8 " 1 3/8	3/8	1/4
1 7/16 " 1 7/8	1/2	5/16
1 15/16 " 2 3/8	5/8	3/8
2 7/16 " 2 7/8	3/4	1/2
2 15/16 " 3 3/8	7/8	5/8
3 7/16 " 3 7/8	1	3/4
3 15/16 " 4 3/8	1 1/8	7/8
4 7/16 " 4 7/8	1 1/4	1
5 " 5 3/4	1 3/8	1 1/8
5 7/8 " 6 7/8	1 5/8	1 1/4

NOTE: In planing or milling keyseats the depth of seat should be one-half the above thickness measured at corner in shaft and hub.

Thickness given is at large end. All drive keys should have a taper of three-sixteenths inch per foot. Plane keyseat in hub tapering. The deepest part of keyseat in hub is to be one-half the thickness of key as given.

Draw keys are to be proportioned as shown.



The desirability of having the keys in pulleys, gears, and shafting of a uniform size, referred to the diameter of shaft, is apparent, and the general adoption of a standard system would be a good step in a right direction.

For special work special sizes and forms could be used, as we now find them. For instance, instead of cutting a deep heavy keyseat into a large shaft we find two lighter keys, placed from 90° to 120° apart, as shown in Fig. 2.

In some cases we find the keyseats are placed about 135° apart, and the keys let into the hub and shaft as shown in Fig. 3. In this case the keys consist of two pairs of slightly tapering pieces which are driven into each keyseat, the opposite faces of which are parallel. For this form of keying the following proportions have been found satisfactory:

$$\text{Breadth of key} = \frac{\text{dia. of shaft}}{8}.$$

$$\text{Thickness of key} = \frac{\text{dia. of shaft}}{16}.$$

The taper of keys is equal to five-eighths inch per foot.

A system of keying somewhat similar to this (shown in Fig. 4) is used to some extent in marine and other engine work, and has been found to stand greater strains, and to hold more securely than obtains with the ordinary sunk key.

For machine tools the system of keying patented by W. N. Woodruff is rapidly gaining in favor among manufacturers, and its more general introduction would, from the very nature of the system, insure a standard of sizes at least in keys for machine tools but it may be questioned if such standard is needed for this class of work.

It certainly would be an advantage, but its advantage would not be as great nor as far-reaching as would be the case if a standard system were applied to the general machinery of transmission, including line shafting, countershafts, jackshafts, pulleys, gears, couplings, clutches, rope and cable sheaves, hoisting drums and similar work.

The Woodruff system, as it is now in use in the shops of the Pratt & Whitney Co., Lodge & Davis Co., Prentice Bros., Reed & Co., and others, possesses many advantages over the ordinary method. Under this system the keyseat is cut into the shaft by means of a milling cutter equal in thickness to the key to be inserted, and of a diameter corresponding to the length of the key.

The key, Fig. 5, being a semi-circle, the cutter is sunk into the shaft as far as will allow sufficient projection of the key above its surface as to engage the keyway in the hub it is designed to hold in position.

There are in the system twenty-five different sized keys and the established scale of standard cutters varies from 1/16 inch to 5/16 inch thick, and from ½ to 1½ inches in diameter, the diameters of shafts for which these sizes of keys are adapted varying from 5/16 inch to 2½ inches. For shafts over 2½ inches in diameter two or more 5/16-inch keys are used.

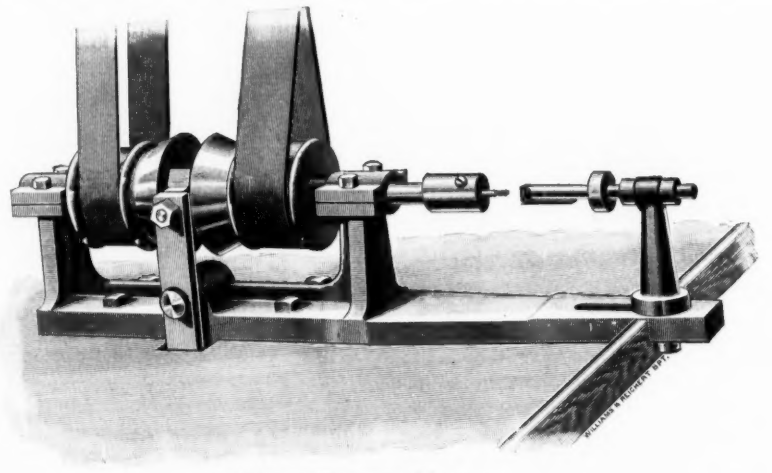
The thickness of key is very much less than that ordinarily employed, but as this thickness was determined from data obtained by testing to that point in which the key would stand the torsional strength of the shaft without shearing, it is safe to assume that the largest sized key given for any diameter of shaft will safely transmit all the power of the shaft.

It is evident, too, that the greater depth of hold increases the resistance to side strain. From the fact that these keys are semi circular in section it will be seen, Fig. 6, that they will readily adjust themselves to any position, and by giving the keyway in the hub a slight taper the gear or pulley may be readily secured. Where it is desirable to put a nut on the end of a shaft or spindle it dispenses with the operation of reducing the diameter in order to avoid cutting into the thread, as shown in Fig. 7.

In talking with a user of this system last summer, he said: "It is the best and most mechanical manner of putting in keys in existence, and its cost has not been over one-fourth of the cost of keying formerly employed in our works." Now, Mr. Editor, I am not an agent for this thing, but I believe if it were better known it would be more generally adopted.

Bench Tapping Machine.

The accompanying illustration is of a bench tapping machine, which has two pulleys driven in opposite directions with a cone clutch between them, the surfaces of which are covered with molded leather. The direction of rotation of the spindle is changed by the movement of a treadle, which moves the clutch by means of the lever shown attached to it. There is a spindle in line with the tap spindle, to which fixtures for holding work may be attached, this spindle being provided with a knurled collar, which, in tapping small holes, is held by the operator, and may be released when the tap reaches the bottom of the hole, or encounters any unusual resistance. By this means breakage of small taps is avoided. The spindle is driven by 2″ belts, and is speeded at 1,200 to 1,500 turns per minute. The machine is made by Mr. H. Hubbell, Bridgeport, Conn.



BENCH TAPPING MACHINE.

LETTERS FROM PRACTICAL MEN.

Blue-prints by Electric Light—Aluminum Instruments.

Editor American Machinist:

In reply to W. S. Leonard's inquiry in your issue of Dec. 1, '92, I would say that I have made blue-prints by electric light and got some very good results. My method was simple and inexpensive, and I herewith describe it.

I had a small blue-print frame 19″x19″ glass, which I suspended from the ceiling in front of an arc light by a light jack-chain. The frame was so hung that the light was about 12″ from the frame and on a line with the center. I found that it required about 45 minutes to make the prints, which at first trial was a deep blue where the light was the strongest, while at the edges it was of a lighter color; but this I afterwards overcame by shifting the frame so the light would be nearer these lighter portions. The paper was prepared in the usual way for sun exposure. As to the balance of his inquiries, I would say that I never mounted my prints, because they are so cheap and easily made that I found it would not pay. The assistant draftsman made the prints, coating paper, etc., and I found that they could be made for about 10 cents per square yard.

I have never used aluminum instruments; but those that have used them inform me that they do not soil the paper any more than rubber, and as to weight, usage, etc., especially triangles, there is no advantage over rubber. H. B HUNGERFORD.

Heating and Cutting of Bearings.

Editor American Machinist:

Many trials have been made to prevent bearings from heating and cutting shafts and a large amount of money has been spent in experimenting with different kinds of metals. The writer is a machinist of long experience, who builds wood-working machinery, where in most cases a fast speed is required, and the higher the speed, the more and better the work.

Referring to the proper length in proportion to the diameter and in proportion to the pressure on a bearing, I find that most bearings are too short. Take, for an illustration, a bearing of 3″ diameter, its length being three times the diameter, or 9″, we get a bearing surface of about 27″. If we now have a pressure of 1,000 pounds on this bearing, and if the shaft runs at a good fast speed, the oil is squeezed out quickly and the shaft bears on the bearing so hard that there is little or no room between the two metals for oil. The result is, that both metals are dry and the bearing is spoiled. The harder the pressure, the sooner it heats, and the less opportunity the oil has to go in and remain between the two metals. If we now make a bearing 3″ diameter and four times the length instead of three times, we get a bearing of about 36″, and with the same total pressure on bearing the pressure per square inch will be reduced proportionately, and the bearing will remain in good condition and last much longer.

I claim, if a bearing is properly constructed and well arranged regarding its oiling, and is not overloaded with pressure, one metal will not touch the other. The oil is always between the two metals, and the little wearing on such a bearing is caused by the grit in the oil, or the oil itself.

I made bearings 2″ diameter and three times their diameter for the length, to do a certain work, and they lasted no longer than a full year, on the average, and caused considerable trouble. Being tired of this trouble, I made a shaft 2½″ diameter and five times its diameter for the length, which had more than double the bearing surface, for doing the same work. These bearings now run eight years, and I have had no trouble whatever. I examined them once and found them in such good condition that some of the turning marks made by the lathe tool could still be seen. It is the same with loose pulleys as with bearings.

I find also on most engines, especially those that have to do work to their full capacity, that the crank-pin heats, and am surprised that our engine builders do not make them larger and longer, and so do away with this trouble of heating. I have also built engines, and have had one for my own use, but made the crank-pin considerably longer and larger than most engine builders make them on such a size engine. This engine was, about three years after its erection, used to its full capacity, and has now been running over 18 years, and the crank never caused me trouble, and is in such good condition that it appears able to run another 18 years or more.

I claim, also, that less oil is consumed. If any one puts a drop of oil or even water on one finger and rubs it with another finger quite hard, the lubricator will squeeze out on the sides and run away. The fingers will then produce heat, as there is no more lubrication to prevent this heat. When this has been tried, put another drop of oil on your finger, but do not press hard, and the lubricator will last much longer.

Some one may say that a longer bearing will cause more friction than a short one, which is not so. It will only happen if a bearing is too long in proportion to its diameter and pressure, but I claim that if a bearing has a proper length, and is continuously oiled, it will take less power than one being too short and not kept properly oiled.

New York. P. PRYIBIL.

Writing on Blue-prints.

Editor American Machinist:

For the benefit of Mr. W. S. Leonard, who wants to write on blue-prints that have been shellaced over, I would like to offer the way I know. Cut a small hole in a piece of paper and lay the paper over the print with the hole where the figures are wanted. Then wash off the shellac with the finger wet with alcohol, taking care not to flood it. After the shellac has dried around the spot, write in the figures with soda dissolved in water. If the paper has a poor surface the figures may run together. In that case cover the whole spot with the soda water, and when dry, figure with black ink.

JOHN C. MATHER.

Fly-wheels.

Editor American Machinist:

The new theory of strains in fly-wheels by Mr. James B. Stanwood, in your issue of Dec 8th, will probably be of great value to designers, and I have followed his analysis carefully.

In order that my remarks may be understood, I shall repeat the symbols used by Mr. Stanwood.

V = velocity of rim in feet per second.
d = diameter of wheel in inches.
t = thickness of rim.
N = number of arms.

F = greatest tensile stress in pounds per square inch of section of rim caused by bending.

T = greatest tensile stress in pounds per square inch of section of rim caused by direct pull.

Mr Stanwood first considers the case where the arms are assumed as without elasticity, and asks: "Under these conditions, what will be the strain upon the ring? The ring between each arm resembles now a uniformly loaded rectangular beam fixed at both ends; *it is also under a tensile strain of* $\frac{V^2}{10}$ *pounds.*"*

This last statement I believe to be incorrect; the strain $\frac{V^2}{10}$ does not exist under the assumed conditions, and the introduction of it in the formulas may lead to serious errors; for, under the conditions considered, the direct tensile strain is in fact so small that it may be ignored, while $\frac{V^2}{10}$ is always a quantity of considerable magnitude

With rigid unelastic arms the ends of the arms are fixed points on which nearly all the centrifugal action of the rim is sustained, and by considering the rim between two arms as a straight bar, we find the greatest *direct* tensile strain due to centrifugal force $= \frac{V^2}{4\ N^2}$ nearly, for a wheel with not less than six arms, and this is always a small quantity compared with $\frac{V^2}{10}$.

I have no desire to criticise Mr. Stanwood's analysis, but the error is too great to allow it to pass, and besides, by leaving $\frac{V^2}{10}$ out of his formulas, they become more simple and pleasing to the eye, and would be more readily accepted, and come into general use.

If, in casting a wheel, the rim is cooled before the arms, then there will be an initial strain in all parts very much like that which would be caused by centrifugal force, if the arms were of a non-elastic material, and if the arms are cooled before the rim, then the strain will be much like that caused by centrifugal force in a ring without arms, or with loose arms, and such strains *may* also occur in built-up wheels.

For a wheel with non-elastic arms, we have

$$F = \frac{.95\ d\ V^2}{N^2\ t}.$$

and for a ring without arms, or with loose arms,

$$T = \frac{V^2}{10}.$$

The strains F and T cannot exist at the same time, and to base calculations on the assumption that, under certain conditions, the fiber strain would be $= F + T$ is certainly wrong. We may have part of strain F and part of strain T, but the greatest possible strain due to centrifugal force will always be either F or T, and never $F + T$.

It will, of course, be safest always to use the formula which gives the greatest possible strain; for instance, to use formula F for ordinary six-armed wheels and pulleys.

Mr. Stanwood's paper is very instructive, and it reminds us that, when practical men do not follow accepted theories, then it is time to subject these to a critical investigation.

J. BEGTRUP.

*The italics are mine.

Cam Rollers—Parallel Strips.

Editor American Machinist:

The comments of Mr. Gribben anent cam rollers do not appear to be favorable to the conical roller idea. Well, the conical roller has the merit of being theoretically correct, if nothing more. I have never seen it tried in practice, but have seen a great many cases of a hard cylindrical roller on a hard stud sticking on stud and the cam (a cast-iron one), wearing a flat on roller and developing a cutting edge and ruining a valuable cam in a very short time. Of course, this can only occur through lack of attention, or where the cam is cased in, as in the case I mention, so its operation could not be seen until the wear or cut on cam was transferred to the work—screws in this instance. The fact that it could not be seen was due to faulty designing, a very common thing, by the way, and the only way I could account for the sticking of roller when well oiled was the fact that the travel of the cam was faster on one end of the roller than the other, as is self evident to any mechanic.

Now a word about parallel strips, those invaluable adjuncts to every shaper and planer. My suggestions on this head are for the benefit of those foremen and their workmen who have never had the pleasure of going to a planer, picking up a pair of strips instanter and getting the work to be planed exactly the right depth in the chuck to use the chuck right (you might need it again, some time), to the right distance above the surface to use, and do the work *right*. It consists in several pairs of strips about $\frac{3}{8}$" thick, the length of the chuck jaws, and of varying widths from within $\frac{1}{8}$" of the height of jaws for the widest pair; the next pair $\frac{3}{16}$" less in width, and so on down to the bottom or narrowest pair of about $\frac{3}{4}$" x$\frac{3}{8}$" section. An outfit like this will do anything—do it quick and right, assuming the bottom of chuck to be true and the strips *paralliel*. The patterns can be made in an hour by anybody who can handle a plane and saw. The machine work can be done in a day by a good man with a good machine; the strips can be used to plane each other by, and when done you will have a sensible, scientific and altogether satisfactory set of strips, and for actual practice worth a ton of the apologies for strips in general use. But the workmanship must be first-class at the start to get results afterward.

H. HARDINGE.

Boiler Compounds.

Editor American Machinist:

As there are various boiler compounds now on the market, and each one better than the other (so the manufacturers claim), I wish to give your readers my experience. I have what I think is the best boiler compound on the market, viz: good water. The boiler which I have charge of is in use fifteen hours a day in fall and winter, and ten hours in spring and summer. The boiler was not cleaned for four months, and when I opened it a few days ago I was actually surprised to find what condition it was in. There was not a single sign of scale, mud or incrustation of any kind to be found, and I am of the opinion that if every user of steam boilers could get the water I am using, the burnt and exploded boiler would not be heard of very often unless caused by over pressure or low water. The water is furnished by the Union Improvement Co, and is piped eight miles. I use no pump, having about 120 pounds pressure at boiler.

W. S. HOFFMAN.

A not unnatural result of the great coal combine is that the charitable institutions of New York find it impossible to distribute as much as usual, hence increasing suffering among the extremely poor.

The trainmen on the B. & O. R. R. receive a Christmas present in the way of an increase of wages, averaging about fifteen per cent.

Jordan's Improved Planer Chuck.

The illustrations accompanying this represent three forms of the Jordan planer chuck as now made by its inventor, Mr. G. W. Jordan, Worcester, Mass. The first of these is with a square base, around which there is an extension for convenience in clamping the chuck to the bed of the machine; the next one shows it with round and graduated base, by which it may be set at any desired angle, and the third engraving shows the same chuck, but with the movable jaw held down by gibs which extend over the side of the chuck at each end, instead of by bolts which engage in T slots and thus necessitate slots in the bottom surface of the chuck. All these chucks are provided with a steel strip at the back of the movable jaw for the set-screws to bear against, and are so arranged that the jaw does not tip nor have any tendency to lift work from the bottom chuck or parallel strips. The jaws are readily moved, to accommodate work of any size within the capacity of the chuck, by simply lifting the

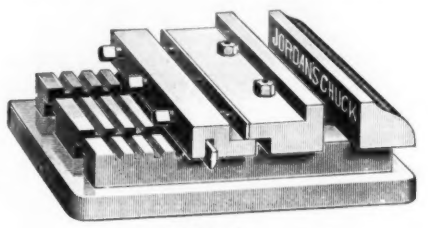


Fig. 1.

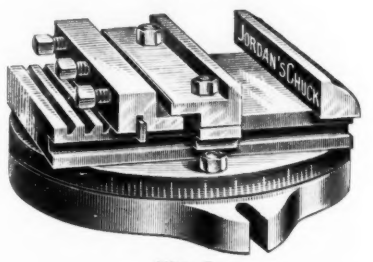


Fig 3.

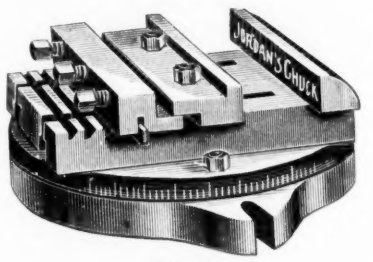


Fig. 2.

steel strip which engages with the grooves cut for that purpose. All these styles are made in various sizes from 8" to 30" length of jaw.

Why Are Gears Noisy?

BY W. H. BOOTH.

Probably, in many cases, because they are badly formed. In fact, I know from experience that a persistent course of bad design of some makes of gears has resulted in a general acknowledgment that such and such a firm's gears were always noisy, and I have found noisiness to be almost invariably accompanied by a hollowing in of the teeth at the pitch line as a result of an excess of metal at the points of the opposite wheel. It is just this excess which tries to dig into the opposite tooth, and causes an impulse at every tooth contact, which causes a different rotative speed from the proper even speed proper to plain

Fig. 1

Fig. 2 *Fig. 3*

cylinders in rolling contact, which ought to be the characteristic of a toothed wheel. The excess at the points has the form of Fig. 1, as shown in solid black, and may exist both above and below the pitch line. In my own experience of gears we were accustomed to find the exact form of the teeth, and then to put in a cutter (I am referring to the cutting of the wooden pattern), which took off a shaving commencing at 0 at the pitch line, and gradually increasing towards the point.

In fact, assuming Fig. 1, outside dimensions, to be correct, we cut off the black portion, and left the point only a little scant. I believe the people who make teeth full at the points, do so because they use rolling curves whose radius is what their diameter really should be. Theoretically, a tooth can be made so long that its two sides meet at a sharp point, and one very good engineer said he would make teeth work as long as his arm, and certainly he did make some very quiet running long teeth, as long, nearly, as their pitch. Twenty years ago teeth were made of a length equal three-fourths their pitch, and I did my best to have them shortened to half pitch, and advised that they should be of the form of Fig. 2 as an aid in casting. Nearly twenty years after this they began to make them so, and the length is made only two thirds pitch. For several years now an engineer of high standing in Lancashire has advised teeth of very small length, and points out that the breakage of heavy gears is due to their needless length, given under the mistaken idea that it was necessary to give a large arc of contact, so as to have several teeth in contact at one time, whereas it is better to aim at the contact of one tooth only, or two. Only one will really make contact until the gears have run for some time, and worn exactly true.

Forty feet per second was the limit for gear velocity. This limit was that of the teeth, not of the rim strength, for belt and rope rims run safely enough at 80 feet velocity. The 40-feet limit was due to the length of the teeth. As for gears, many large wheels of good design run quietly with a rubbing length not half the tooth, it was obviously possibly to shorten the teeth to half their length, and thereby to secure early contact over the whole tooth length whilst destroying the chance of breakage from a blow on the end of the tooth—so serious with long teeth. A recognition of the necessity in long teeth of the trimming down shown in Fig. 1 led some makers to overdo the remedy, and we had teeth, as in Fig 3, excessively round on the face, and, as a result of carrying a good practical correction too far, the gears would again be noisy, for the two-barreled teeth flattened each other at the pitch line, as per the dotted line in Fig. 3, and contact did not creep gradually towards the points.

With short teeth there is not that dangerous obliquity of meeting which is so destructive of teeth, and there are those who so far object to this that they will make a pair of wheels so that all action takes place after the line of centers has passed, the driver having the teeth almost wholly above pitch circle, or all points, and the driven wheel being pretty well all flank, of course, this prevents wheels being made in sets, and so is applicable, as a rule, only to special cases or to bevels.

In reading most treatises on gearing we find a great deal about limiting numbers of teeth, angles of obliquity, arc of contact, and there is quite a heavy sprinkling of trigonometry on every page. Now it seems to me that the amount of mathematics necessary in the gear problem is in about the ratio of the (length of tooth)^3. The shorter the teeth the smaller will be the amount of figures necessary. In a tooth of 4 inches pitch, only $\frac{3}{4}$ inch long, even an incorrect diameter of rolling curve would have but small effect upon the profile of the tooth. The use of ropes in heavy driving arose almost entirely from the necessity of a greater than 40-foot rim velocity of fly-wheel, and there is a tendency to return to gears, owing to the large frictional resistance of ropes. Should short teeth become recognized as correct, it seems very likely that such a tendency will grow into actual fact. The engineer to whom I refer is Mr. Longrule, and is of excellent standing, and though I may claim precedence of him in my advocacy of short teeth, we must both give place to that Mr. Hawkins who supplemented the English translation of Camus on the Teeth of Wheels, and gave outlines of both epicyclic and involute teeth, which he recommended should not be above one-half pitch in length. This is many years ago, and only now is the obvious truth getting a hearing.

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NEW YORK, JANUARY 5, 1893.

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Business Prospects for 1893.

In this issue we publish a large number of letters from leading manufacturers in the country. In our next issue we shall publish about as many more. These letters, coming from men who are all the time in sympathy, so to speak, with the manufacturers of the country, will have especial interest to our readers.

It will be noticed that the general tone of these letters sets forth a bright prospect for the year 1893. The news is of enlargement of works and an increase in business.

Some of our correspondents express fears of tariff legislation that may affect, adversely, matters of manufacture. As we have expressed ourselves before, we do not believe anything of the kind probable, or even possible. No party is likely to come into power with the intention of ruining, or tending to ruin the country.

In our opinion the year 1893 will show an equal or greater progress than 1892. Everything points in this direction; not only the letters we receive, but talks with those interested in the manufacturing enterprises of the country, point to this conclusion.

If every one works for the best interests of the country we shall surely see our home and foreign trade greater in 1893 than ever before.

Responsibility Without Control.

Many marine and naval engineers have taken the trouble to commend in various ways our position with regard to the Danforth case, most of them, however, not wishing their names mentioned in connection with the affair, for obvious reasons.

The whole question of the relation of engineers to the other officers on shipboard finally resolves itself into the question which we have before discussed, *i. e.*, how far can a man be fairly held responsible for that which he cannot control, and if the attempt is made to hold him responsible for things over which he is given no control, how much of this can he be expected to stand before he begins to make trouble or makes room for others who have less spirit or less ability, which often means the same thing?

It is perfectly safe to say that no man possessed of brains ever did himself justice in trying to attain results when restricted and interfered with as to the means of attaining them, and especially when the person interfering knows nothing whatever of the matters he is meddling with.

Politeness has been defined as "listening patiently to an explanation of a subject the listener knows all about by a person who knows nothing about it." Very few persons are willing to put their politeness to such a test, and it is worse for a mechanic who makes a business of knowing certain things and of attaining certain ends, to be directed and interfered with by some one who knows nothing of mechanics — not even enough to form a basis for an intelligent argument or explanation. Most mechanics know that, generally speaking, it is difficult to work under the immediate direction of a man who is not himself a mechanic, for it is very rare that such a man knows just how far he should go in giving directions, and what should be left to the mechanic himself. It is very trying to most mechanics to be left in the dark respecting important points that no one but the inventor of the machine being built can possibly know, while hours are spent in discussing methods of drilling and tapping holes, the necessity for lard oil in chasing threads, or some such matter which the machinist ought to know if he be supposed to know anything, and which ought to be left to him entirely.

The same principle applies to a marine engine. Certain results are to be attained by its use. These results are: the movement of the ship at any desired rate within the capacity of the engines; economy in consumption of coal and in repairs, and safety of the occupants of the ship from the consequences of wrecking or failure of any part of the steam plant. Absolutely no one but a trained engineer, who must usually have been previously a good machinist, can know how to secure these results and actually go into the engine room and secure them. This being the case, it ought to be self-evident that the man in charge of the engines and machinery of a naval vessel should be held responsible for nothing whatever except for the result aimed at in the construction of the machinery. If a signal comes to the engine room to start or stop the engines, increase their speed or to slow them, and the order is not carried out, then the engineer should be responsible to the captain for the failure, and this is about as far as his responsibility to him should extend. Within the engineer's department he should have absolute control. And to this basis matters will eventually be settled, without doubt, for there is no other basis upon which they can permanently rest.

Apprenticeship.

While we cannot speak with so much certainty regarding other trades, we feel very certain that, so far as the machinists' trade is concerned, there is almost or quite nothing in the cry that organizations of workingmen are preventing American boys from serving apprenticeships, and that the ranks of the skilled workmen are for this reason necessarily recruited from among foreigners.

One reason for our thinking that the effect of organizations in other trades is very much overrated is that we frequently see statements regarding this matter which will not bear investigation and comparison with other facts. For instance, recently we have seen a statement purporting to have originated with Col Auchmuty, who is at the head of the New York trade schools. The Colonel (who no doubt is doing a very good work with his school) is continually lamenting the fact that American youths are prevented from learning trades by the wicked trade organizations, and the statement to which we refer gives the amount of money paid to workingmen in New York City, and the very small proportion of it which is paid to men who are native born citizens, the reason for this being, of course, the obstructive efforts of the trade unions. Any one who wishes to get the best possible answer to this charge has only to take a walk along Broadway and note the names on the signs over the business houses. There are so few names that are not palpably foreign that they cut a very small figure indeed, and we venture to say that the proportion of money earned as profits in business done on Broadway, that goes into the pockets of native-born Americans, is smaller than the proportion of wages earned by American-born mechanics in New York. And does any one pretend that trade unions are responsible for this?

New York is emphatically a cosmopolitan city, and the proportion of foreign-born men engaged in almost any pursuit that can be named is much larger in New York than in any other city in the country. There are other peculiar conditions here which make of it anything but a representative American city, and we think this is especially true of the mechanical trades. Yet there are men whose observation seems to be confined to the city and its vicinity, and who give evidence of knowing very little of workmen outside of it, that are continually publishing their views as to what is the matter and what the proper remedy should be.

The plain fact is that many of the men who are metaphorically weeping over the desperate position of the young American who is barred out from the opportunity to learn a trade would not have their own sons serve an apprenticeship to a trade, so long as there was anything else which they could do. And it is to be remarked that the sons usually prefer to do something else, too, if possible; and while we may condemn the choice of these fathers and sons, and point out the serious mistake they are making, to our own complete satisfaction, a little more modesty might lead some of us to consider that these fathers and sons perhaps know what they prefer, and, in short, know their own business better than any one else can tell it to them; and the boy who has no taste for mechanics, and who would prefer to sell dress goods or to go into a commercial office, is in nine cases out of ten better off there than he would be in a machine shop, and the machine shop is better off without him than with him. It is just as true that the boy with commercial tastes is better off in a commercial occupation as that the boy with mechanical tastes is better off in a mechanical business, and, although this seems self-evident and trite, it is much too often forgotten by those who discuss these matters.

But so far as the machinists' trade is concerned the decadence of the apprentice system—so far as this has taken place—is due mainly to the fact that a very large proportion of machine shop proprietors no longer want to employ apprentices, the chief reason being that they interfere too much with the systematic arrangement of work, and tend towards a complication of the problem of the most efficient shop management.

The Cause of an Accident.

The importance of closely watching the small and apparently unimportant things about an engine was illustrated by the C. R. R. of N. J.'s ferry-boat "Fanwood," which recently ran into the slip at the foot of Liberty street and struck the bridge with such force as to drive it back towards the street and nearly wreck the ferry-house. The cause of the accident was the dropping from its place of a small pin in a lifting connection, or the small rod connected to the starting shaft, the duty of which is to lift the eccentric hook off from the wrist-pin of the rock shaft. These boats run at full speed as near the slip as they dare, and then stop by reversing the engine. In this case the engine could not be reversed, and the momentum could not, therefore, be checked.

The pin which dropped out was secured in place by a split key, and was below the engine room floor, where it could not be so readily seen as it otherwise might have been.

It is probable that the importance of the eccentric rods and rock-shaft are fully recognized, and that they are frequently examined and known to be in good order. But this small pin proved of equal importance at a critical moment, and it is very doubtful if it and similar pins and connections receive their fair share of attention. A split key is not a proper method of holding any pin which, by dropping from its place, may result in a wreck. All such pins should be held in place by a nut, and this nut should be pinned or otherwise locked in place. Then frequent and thorough inspection will reduce the chances of such an accident to almost nothing.

Our readers, as they pick up this, the first number for the new year, will notice that the pages look somewhat different from those of preceding years. This is not due to "entirely new designs," but simply to the fact that modern ideas require that we should dispense with column rules, which are, accordingly, dispensed with, the tendency in this being, as in machine design, to drop unnecessary features and look toward simplicity. We like the change and hope our readers will be pleased with it.

The editor of this paper begs to acknowledge the receipt of a large box of assorted pencils from the Jos. Dixon Crucible Co., of Jersey City, N. J. As he always uses these pencils, the credit will go to the purchasing department, but the courtesy is appreciated just the same.

He also desires to acknowledge the recepit of two boxes of cigars from the Pittsburgh Locomotive Works They are already fast going up in smoke, and with the smoke goes kind remembrances. We are awaiting another Christmas.

Literary Notes.

The December number of *The Foundry*, a new journal devoted exclusively to foundry matters, has reached our table, and, in our opinion, will undoubtedly commend itself

to every practical foundryman. It is published in magazine form, with cover, and has 32 pages of reading matter, in which we find practical articles by well-known writers on foundry matters. The editor of the new journal, Mr. John Penton, is a foundryman, and we welcome this new and creditable addition to the field of technical journalism. It is published monthly by the Foundry Pub. Co., Detroit, Mich. Price $1 per year.

Professor Horace B. Gale, M. E., of San Francisco, publishes in pamphlet form the record of a test of the efficiency of Hydraulic Passenger Elevators, and a comparative test of the Hydro-steam and Pumping Systems. His tests show that the two systems are almost identically equal in efficiency where compound pumping engines are used in the last-mentioned system.

QUESTIONS AND ANSWERS.

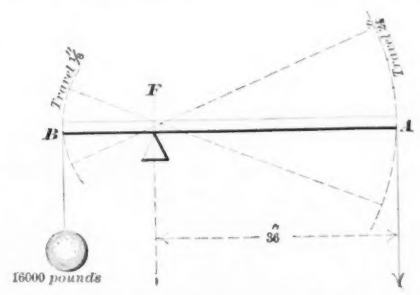
Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(1) ——, Hamilton, Canada, writes: I would like to have a rule or formula for finding the thickness of the walls of a steam engine cylinder, one that will hold good under any pressure, and still give thickness enough after the cylinder has been worn and then trued up. *A.*—Multiply the diameter of the cylinder in inches by the steam pressure per square inch; also multiply this product by the constant decimal fraction .0001; add to this last product the square root of the diameter of the cylinder in inches multiplied by the constant decimal fraction 15; the result will be the thickness of metal in the barrel of the cylinder. To show the application of this rule we will work out the following example: What must be the thickness of metal in the barrel of a cylinder 49 inches in diameter; steam pressure 60 pounds per square inch? Here we have $(49 \times 60 \times .0001) + .15\sqrt{49} = 1.34$ inches for the thickness of metal. To this should be added say $\frac{1}{8}$ inch, to allow for wear. 2. Does the governor of a steam engine control the number of revolutions per minute of engine? *A.*—Within reasonable limits it does.

(2) H. G. P., Sheboygan, Wis., writes: I am a machinist, and not long ago I was called upon to examine a gas engine, which was out of order. But, knowing nothing of this class of engines, I did not care to spend any time with it. The owner of the engine explains the case as follows: It used to explode once in about every five or six revolutions, and gave all the power needed. Now it explodes almost at every stroke, and the engine can be stopped by pressing the hand on the fly-wheel. I have been there and have seen it. I thought it might be the fault of the exhaust valve, which seemed to leak. I repaired it, but it did the engine no good. I hate to do any more such guess work, and therefore ask you for advice. It is a five horse-power engine. Whose make it is I do not know, as the builder's name is not on it. If you can tell me where to look for the evil, or if you can make any suggestions in your Question and Answer columns, I should be very much obliged. *A.*—In many gas engines the products of combustion will in time clog up the pipes, and we believe that this is the cause of the trouble in your case. Of course, if we had known the name of the builder of the gas engine we would be in a better position to advise you.

(3) "Straight Forward," New York, asks: Is it customary in the profession, when a draftsman receives a set of drawings, a few of which are partially, and the rest wholly finished, to erase the name of his predecessor from any of the sheets and substitute his own? Would he not thus steal credit for what he never did? *A.*—This is a question which is not so easily answered as might appear at first glance. If each of the draftsmen concerned is nothing more than a draftsman, and is responsible only for the drawings, not for design, then only the name of the draftsman who made any given sheet should appear upon it. But if the second man is to be in any way responsible for design, or for anything more than drawings, then it would appear that his proper course would be to sign sheets of drawings previously made as "approved" by him, but not to erase the name of his predecessor. We think it is not "customary" for draftsmen to pursue the course indicated by you, and think there are very few, if any circumstances under which such a procedure would be justifiable. Where, as is usually the case, the draftsman is to be held responsible for the finished machine or structure going together all right, it is of course necessary for him, in case some of the drawings have been completed, to go over them and thoroughly understand them. He should then sign them as "approved," or, if he finds it necessary to make changes, mark them "altered by A—— B——."

(4) ——, Buffalo, N. Y., writes: Kindly give me a formula in your Question and Answer columns for computing the force applied at the end A of a lever (see sketch) to raise 16,000 pounds applied at the end B. The arm $A\,F$ is 36 inches long, and the point A travels through an arc 24 inches long; the point B is to travel through an arc $\frac{1}{8}$ inch long; the length of the arm $B\,F$ is unknown. *A.*—The first step is to compute the length of the arm $B\,F$. The point A travels through an arc $24 \times 8 = 192$ times longer than that through which the point B travels, consequently the arm $A\,F$ must be 192 times longer than $B\,F$, which gives us $\frac{36}{192} = .1875$ inch for the length of the arm $B\,F$. Now the



weight applied at B into its arm $B\,F$ must be equal to the force applied at A into its arm $A\,F$; hence we have

$$16{,}000 \times .1875 = 36 \times x,$$

in which x denotes the force in pounds applied at A; from which we get

$$\frac{16{,}000 \times .1875}{36} = x = 83.33+ \text{ pounds}$$

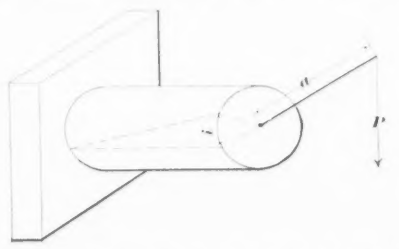
(5) W. R., Frederick, Md., writes: I find no correct rules in reference to torsion or twisting in degrees of shafting. In an engineers' pocket book I find the following formula: Twisting in degrees $= \frac{425 \times F \times R \times l}{x \times D^4}$. I also find in the same book a practical example referring to this formula, namely: The crank $R = 3.5$ feet, force $F = 3{,}860$ pounds, length l of shaft $=$ 64 feet, diameter $D = 5.25$ inches; required the twisting in degrees. The shaft being of wrought-iron, a value of 4,110 is taken for x. Substituting for the symbols their values, we have:

$$\frac{425 \times 3{,}860 \times 3.5 \times 64}{4{,}110 \times 5.25^4} = 117.6.$$

But the answer in the book is 11.76 degrees. Now how can it be 11.76 degrees? *A.*—There is evidently a mistake in the formula, and for this reason we should not use it. We prefer to use the following formula:

$$i = \frac{10.2 \times P \times a \times l}{C \times d^4},$$

in which i denotes the angle in circular measure; that is, the length of the arc i is given in parts of the radius, as we shall presently show; P the force in pounds applied at the end of the arm a, the latter being taken in inches; l the length of the shaft in inches; C a constant; for wrought-iron its value is generally taken at 9,000,000,



and d the diameter of the shaft in inches. Applying this formula to the given example, we have $P = 3{,}860$ pounds; $a = 42$ inches; $l = 768$ inches, and $d = 5.25$ inches; substituting these values for the symbols in the formula, we have:

$$i = \frac{10.2 \times 3{,}860 \times 42 \times 768}{9{,}000{,}000 \times (5.25)^4} = .185;$$

this means that the length of the arc i is equal to $\frac{1.85}{1000}$ part of the radius of the shaft; this radius always represents 57.3 degrees, hence the angle through which the shaft is twisted is equal to $.185 \times 57.3 = 10.6$ degrees. 2. I experimented on a $\frac{1}{2}$-inch rod which our blacksmith bent for me. I put one end of it in the vise, and at 5 feet from the vise it passed through a board, leaving an arm 2 feet long, and bent perpendicular to the rod on the outside of the board, which was carefully marked off in degrees around the hole. I placed a 12 pound weight at the end of the arm, and it gave me a twist of 17 degrees. Computing the twist by the formula given in the engineers' pocket book, I obtained 199+ degrees, and I think it should have been 19.9 degrees. Where is the error? *A.*—As stated before, we should not use that formula, but should use the one we have given. Applying this formula to your experiment, we have $P = 12$ pounds; $a = 24$ inches; $l = 60$ inches and $d = .5$ inch. This gives us:

$$i = \frac{10.2 \times 12 \times 24 \times 60}{9{,}000{,}000 \times .5^4} = .313;$$

multiplying this result by 57.3 we obtain $.313 \times 57.3 = 17.93$ degrees. 3. Please inform me how many degrees of twist is allowable. I believe that 1 degree in 10 feet length of shafting is not excessive. *A.*—Authorities differ in regard to the angle of torsion. We should not expose the outer fibers of the shaft to more than $\frac{1}{10}$ of the ultimate stress.

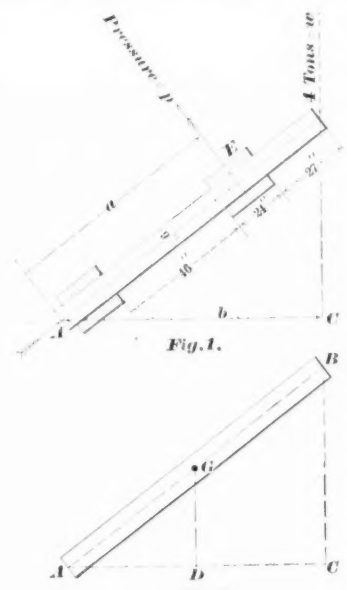
(6) W. M. A., Cleveland, O., writes: Please answer the following questions through your columns: 1. What will be the pressure on the bearing E of an inclined shaft as shown in Fig. 1, with a load of 4 tons acting in a vertical direction through the upper end B of the shaft? *A.*—Let $A\,B$, Fig. 1, be the axis of the shaft, its length being equal to the length of the shaft. Through the upper extremity B draw a vertical line $B\,C$, and through its lower extremity draw a horizontal line $A\,C$, meeting $B\,C$ in C. Let us designate the distance from A to the center of the bearing E by a, and the distance from A to C by b; also let us denote the load of 4 tons applied at B by w, and the pressure on the bearing E by p. We may assume that the shaft is free to turn around the point A; under these conditions the load w will act with a leverage b; therefore its moment will be equal to $w \times b$. The pressure p on the bearing acts with a leverage a; its moment will be $a \times p$, and for equilibrium we have

$$w \times b = a \times p;$$

from this we obtain

$$p = \frac{w \times b}{a}.$$

We have therefore the following rule: Multiply the load in pounds applied at the end of the shaft by the distance b in feet, and divide this product by the distance a in feet; the quotient will be the pressure in pounds on the bearing E. Of course this pressure is that due to the load only. To this must be added the pressure on the bearing E due to the weight of the shaft, which is found as follows: Let G in Fig. 2 be the center of gravity of the shaft, and let us denote the distance from A to D, that is to the foot of the vertical line through G by c, and the weight of the shaft by s; we have then, by reasoning similar to the foregoing,



$$s \times c = a \times p_1,$$

from which we obtain

$$p_1 = \frac{s \times c}{a},$$

and this pressure must be added to the pressure due to the load as found above; the sum will be the total pressure on the bearing. 2. What will be the thrust at the bottom of the shaft in the direction of its axis as indicated by the arrow at A? *A.*—Draw the axis $A\,B$ of the shaft as shown in Fig. 2, the axis being equal to the length of the shaft. Through the extremity B draw the vertical line $B\,C$, and through A the horizontal line $A\,C$, as was done in Fig. 1. Now the thrust along the axis $A\,B$ will be as much less than the load as $B\,C$ is shorter than $A\,B$. Hence multiply the load by the length $B\,C$, and divide the product by the length of $A\,B$; the quotient will be the thrust in the direction of $A\,B$ due to the load alone. To this must be added the thrust due to the weight of the shaft. Let G be the center of gravity of the shaft; through this point draw the vertical line $G\,D$, meeting $A\,C$ in the point D. Now the thrust at the bottom due to the weight of the shaft will be as much less than the weight of the shaft as the distance $G\,D$ is shorter than $A\,G$. Hence multiply the weight of the shaft by the length $G\,D$, and divide this product by the length of $A\,G$; the quotient will be thrust at the bottom due to the weight of the shaft, and this added to the thrust due to the load will be the total thrust. 3. In computing the deflection of the upper projecting end of the shaft, is it correct to call the load 4 tons? *A.*—No. To find the deflection of this end assume it to be fixed in the bearing and loaded at a distance of 27 inches from the bearing, with a load equal to the pressure on the bearing due to the load of 4 tons acting in a direction perpendicular to the axis.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gear Advertisement is always on page 11.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Forming Lathes. Mer. Mach. Tool Co., Meriden Ct.

Ideal Drawing Stands. M. C. Hammett, Troy, N.Y.

$10 Countershafts. A. D Pentz, Elizabeth, N. J.

Tool Holder. Armstrong Bros. Tool Co., Chicago.

New lists of cutters. Brown & Sharpe.

Norway Rivets. Evans & Robertson, Cincinnati, O.

6 Spindle Turret Drills. A. O. Quint, Hartford, Ct.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"The Bulldozer" a new departure: forging by pressure. M'f'd by Williams White & Co., Moline, Ill.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Drill Presses, with Tapping Attachments.
Gould & Eberhardt, Newark, N. J.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

S. A. Smith, 23 S. Canal St., Chicago, Ill., is agent for Standard Tool Co.'s Twist Drills.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Castings for small and medium-sized vertical engines. Humphrey's Foundry, Bellefontaine, Ohio.

Clayton Air Compressor Works, 43 Dey St., N. Y. Compressors for experimʼts to 300 lbs. pressure, $50.

For Cypress Tanks and Vats, address W. E. Caldwell Co., Floyd and Main Streets, Louisville, Ky.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

"Shapers (Double Triple Quick Stroke")
Trade Mark.
Gould & Eberhardt, Newark, N. J.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

For best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves T. Kieley, 11 W. 13th St., N. Y. Send for des'n.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg Co., cor. Canal and Washington Sts., Chicago, Ill.

Name and Address of the Machine Shops in Ohio, Indiana, and part of Pennsylvania. $1.50. A. W. Hick, Sidney, O.

We electrotype illustrations and advertisements for manufacturers. Prompt and thorough service. Send for estimates. A. Mugford, Hartford, Conn.

Gear Cutters, Auto. Specially adapted for Motor Gears and all other style Gears.
Gould & Eberhardt, Newark, N. J.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide. S. A. Smith, 23 S. Canal Street, Chicago, Ill., Western Agent.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Engine Foundations in Power Plant, World's Columbian Exposition.

By the end of the year, all except two of the engine and dynamo foundations for the electric power and lighting plant will be completed and ready for placing the engines. Those for the 500 H. P. Allis and the General Electric Company's 1,000 H. P. engine will be begun shortly.

There are in all some seventy-five of these foundations, the largest of which is that for the four 1,000 H. P. Westinghouse direct-connected engines and dynamos. It is a solid block of concrete 95 feet by 41 feet, by an average height of 10 feet.

Several conditions have combined to limit the designers of these foundations in the choice of their dimensions. The foundations must be sufficiently high, of course, to reach from the basement to the main floor, while they can be but very little deeper than that, on account of the foundations of the building itself. The building rests upon sand, and any excavation below the level of its foundations (which are 10 feet 6 inches below the floor) is apt to cause troublesome settling. These conditions practically limit the height of foundations to 10 feet, thus making those for the smaller engines heavier than necessary, while many of the larger foundations must make up in breadth what they lack in height. The Westinghouse foundation above referred to is an example. As these engines are vertical they require very deep foundations, much deeper than it was possible to allow them, so the four foundations were combined into one—long and broad, and of massive weight.

In the case of the 2,000 H. P. Allis and the 1,000 H. P. Fraser & Chalmers engines another difficulty presented itself—how to make pits sufficiently deep to accommodate their immense fly-wheels without the expenditure of a large sum of money. These two difficulties were overcome by raising the entire section, engines, dynamos and floor, 2 feet 5 inches above the floor of Machinery Hall. This raised section will be approached by stairs on three sides, the top one being in the nature of a landing where visitors can stand and view the machines to advantage.

Some of the foundations are built entirely of concrete, the remainder are of brick resting on a concrete bed from three to four feet deep. The bricks are well chosen for color and hardness; Portland cement is being used throughout, and broken stone is being used in the concrete in preference to gravel.

The Straight Line Indicator.

The peculiarity of this instrument, of which a sectional view is given in Fig. 1, lies in the simplicity of its parallel motion device, and in the auxiliary spring that allows it but one working surface, thus preventing the appearance of any backlash. These are very superior features; first, in the lightness of the moving parts throughout, and the placing of the guiding mechanism near the fulcrum, that it may have but little movement so that the momentum of the moving parts is so slight as to be no longer a disturbing element, even at the highest speeds. The auxiliary spring also prevents any looseness appearing, and the accuracy of the instrument can never be impaired by use. The guiding mechanism consists simply of a small cam *J*, firmly riveted to the pencil arm, the face of the cam being held by the spiral spring *S* against the roller *M*. This roller has a fixed bearing on the upright *N*. The cam rocks upon this roller, and is so formed as to cause the pencil point to move in a straight line. The guiding mechanism, it will be seen, is placed so near the fulcrum as to obviate a high velocity of the cam, which simply rocks back and forth on the roller, turning almost on the same point of contact while taking a card of average height, and will give a perfectly straight line throughout the whole range of its movement.

The piston is fitted with special accuracy. It is connected with the pencil arm by an inner and outer rod, which screw together, thus furnishing the means for elevating the pencil on the drum for condensing engines. This inner rod is split, so that the wear can be taken up. In the cut the spring is shown partly disconnected, to more clearly represent the mode of attachment to the piston and cylinder head. The springs are provided with heads that take a firm hold on the outer coils, without the aid of solder, leaving nothing but the free coils to do the work. These coils are ground in such a way that the spring will stand compression to the fullest extent and without tendency to bind sideways.

The drum is made as light as possible, with a very wide bearing at each end, the drum spring being ground concave on the sides, to avoid all frictional resistance from this cause. The drum spring can be set to any tension desired, by first removing the drum by unscrewing the milled nut upon it, and loosening the wing nut inside. The milled disk can then be turned to the desired tension and firmly locked

This instrument is sent out in a polished cedar case, with nickel mountings, and a special device to secure it in its place. The outfit includes three springs, oiler, wrench, screw-driver, cords, scales, pencils and pad of cards.

Fig. 2 shows the "Dandy" reducing wheel. With this wheel the reduction of

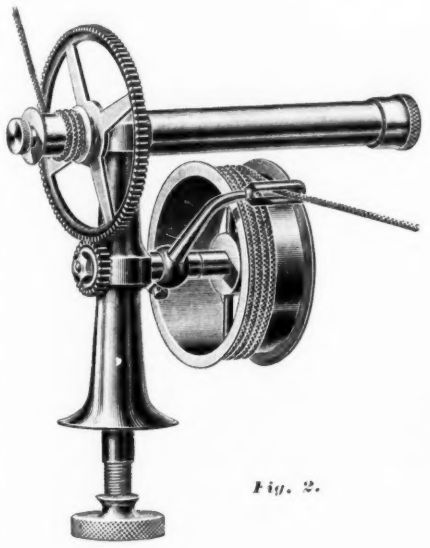


Fig. 2.

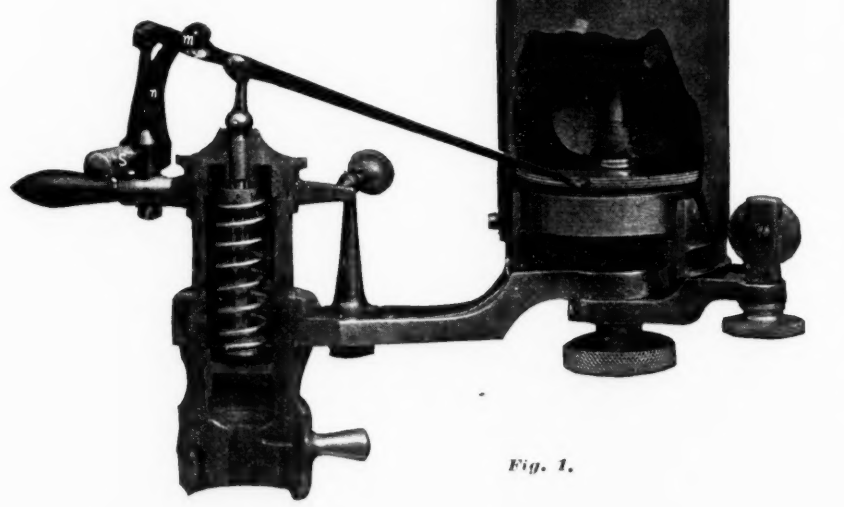


Fig. 1.

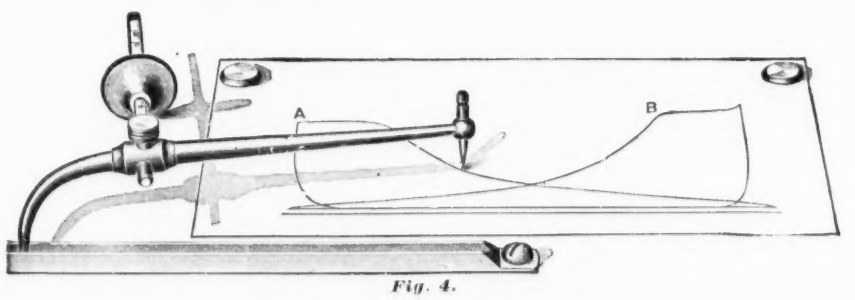


Fig. 4.

THE STRAIGHT LINE INDICATOR.

motion is accomplished by means of a pair of machine cut gears, in the ratio of 1 to 4. The teeth, being always under tension in one direction only, run smoothly, without noise, under the highest speeds The great feature of this device lies in the advantage of having a small, light wheel for high speeds, and a large, wide faced wheel for long strokes, when just the reverse would be required were it not for this arrangement of gears.

Fig. 3 represents a three-way valve, with cap to protect the seat and threads from all foreign substances when the indicator is not in use, and with expansion joint complete.

Fig. 4 shows the new planimeter. This instrument acts on an entirely new principle, which avoids all slipping motion of the recording wheel on the drawing board. The wheel is made knife-edged, is free to move on its spindle, and reads by the distance it has traveled in the direction of its axis. It is perfectly accurate and is packed in a polished case large enough to form a drawing board to work upon, with clips to hold the diagrams in place.

These instruments and attachments all exhibit the finest workmanship, are nickeled in all their parts, and are sent out under the fullest guarantee. Messrs. Hine & Robertson, corner Cortlandt and Greenwich streets, New York City, are the manufacturers of these instruments.

Performance of Injectors.

We have addressed the following letter to a large number of injector manufacturers, in the hopes of getting information. We publish it here, believing that many of our readers may have had experience in the matter that will be valuable if published. We shall be pleased to hear from them if they have something interesting to communicate:

GENTLEMEN: An inquiry has been addressed to us, which we think is entitled to a more complete and authentic answer than we are able to give off-hand. We are, therefore, addressing a duplicate copy of this letter to each manufacturer of injectors in the country, and will thank you to write us, with liberty to publish your reply, in answer to the following question:

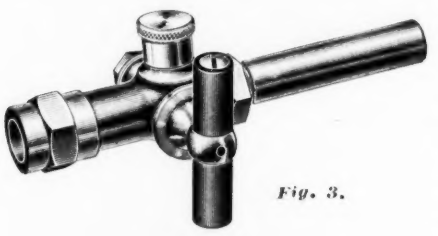


Fig. 3.

What has been the best performance of the injector in raising or lifting water to any height? That is, the greatest volume or weight of water raised, relative to height, with a given weight of evaporated water (steam). Also the pressure of steam and temperature of water before raising?

Of course you will appreciate that what is wanted is a record of actual performance, with statement of where and when done, and under what circumstances.

Yours truly,

It is estimated that the cost of a vessel to defend the cup held by the America over a good many years will cost $70,000. It is a good deal to pay for a boat that is good for nothing but racing, but we hope that some syndicate will conclude to build it. There should be some sport mixed with work.

MANUFACTURES

The Cleveland (Ohio) Twist Drill Co. has issued a very complete catalogue of drills, and the various appliances which are made at the works. Their list of sizes of drills is remarkably complete, and the illustration of appliances is equally so.

The Wilmington City Electric Co., of Wilmington, Del., have placed the contract for their new boiler house with the Berlin Iron Bridge Co., of East Berlin, Conn. The building will be made entirely of brick and iron, from the designs of the Berlin Company.

The Berlin Iron Bridge Co., of East Berlin, Conn., have secured the contract for a new iron fire-proof storehouse for the Pope Mfg. Co., at Hartford, Conn. The building will be 40 feet wide by 84 feet in length, two stories high, and will be used for storing the separate parts of bicycles, as the Pope Co. have to carry a very large stock of the different parts to supply the wants of the numerous users of the Columbia Safety.

There is water-works agitation at Santa Clara, Cal; Fergus Falls, Minn.; Winnipeg, Man.; Groesbeck, Tex; Key West, Fla.; Falconer, N. Y.; Alameda, Cal.; Dothen, Ala.; Meredith, N. H.; Woodbury, Conn; Albany, N. Y.; Raymond, N. H.; Scotland, S. D.; Newburyport, Mass.; North Andover, Mass.; Victoria, B. C.; Brooklyn, N. Y.; Waco, Tex.; Altoona, Pa.; Philadelphia, Pa; Cincinnati, O.; Sioux City, Iowa; Streator, Ill.; Washington, D. C.; Spokane, Wash.; Atlantic City, N. J.; Rock Island, Ill.; Springfield Ill.; Des Moines, Iowa; Peterborough, Ont.; Corsicana, Tex.; Babylon, L. I; Raymond, Mass.; Laredo, Tex.; Doon, Iowa; Mauch Chunk, Pa.

The Lunkenheimer Brass Mfg. Co., Cincinnati, O., make the following announcement: The increased demand for the Lunkenheimer brass and iron specialties, and the introduction of new products, has compelled us to double our capital to $500,000, and as soon as possible our manufacturing facilities. This will place us in position to give all orders even more prompt and satisfactory attention than here, tofore. The company will, after January 1st, 1893, transact its business as the Lunkenheimer Company, with officers as follows: Edmund H. Lunken, president; C. F. Lunkenheimer, vice-president and treasurer; D. T. Williams, secretary.

The J. H. McEwen Manufacturing Co., Ridgway, Pa., send the following list of recent sales: Scranton Glass Co., Scranton, Pa., one 180 H. P. simple engine; Rix & Birrell, San Francisco, Cal., two 35 H. P. simple; Moffett, Hodgkins & Clarke Co., Marshfield, Wis., two 100 H. P. simple; Bank of New York, New York, two 50 H. P. simple; Perry Elec. L. Co., Perry, Iowa, one 100 H. P. simple; Charlottesville Uni. Elec L. & Gas Co., one 125 tandem compound; Horton Land and Lumber Co., Barfield, Mo., one 250 H. P. simple; Moffett, Hodgkins & Clarke, Medina, N. Y., one 100 H. P. tandem compound; Old Pittsburgh Coal Co., Hymera, Ind., one 160 H. P. simple; Hope Lum. Co., Harlton, Tex., one 80 and one 300 H. P. simple; John E. Du Bois, Du Bois, Pa., one 60 H. P. simple; Du Bois Traction and Pass. Ry. Co., Du Bois, Pa., one 150 H P. simple; V. Falkenau & Bro., Chicago, three 70 H. P. simple; O. L. Packard Machinery Co., Milwaukee, Wis., one 35 H. P. simple; Marx & Rardolle, 163 William St., N. Y., one 70 H P. simple; Jeffrey's Manufacturing Co., Columbus, Ohio, one 125 H. P., one 140 H. P., and one 160 H P.; H. P. Gregory & Co., Portland, Oregon, one 35 H. P.; Edison Electric Co., La Grande, Oregon, one 140 H. P.; Central R. R. Co., New Jersey, two 35 H. P. simple.

Walburn-Swenson Co., 1520 Monadnock Block, Chicago, make an announcement as follows: The entire plant of the Fort Scott Foundry and Machine Works, established at Fort Scott, Kansas, in 1869, and owned by the Walburn Swenson Co., is now being removed to their new buildings at Chicago Heights, Cook County, Illinois. During the last few years a large trade for the special lines of improved machinery manufactured by this company has been established throughout the Eastern and Middle States, and also for export. To meet the requirements of the business we were obliged to seek a more central location, and after considering carefully the best manufacturing facilities of many cities, we finally decided in favor of the great city of Chicago as the most desirable point, both for the manufacture and shipment of our special lines of machinery, and the general product of our works. In the growing manufacturing suburb of Chicago, known as Chicago Heights, we have erected new brick buildings on the same general style as our works at Fort Scott, but of twice the size, and which, with the new machinery we are adding to the plant, will more than double our present capacity. We have also largely increased our highly skilled forces in every department of the business. The removal of the works and business will be entire and complete in all their details, including our experimental concentrating works. Our entire stock of patterns, being the accumulation of over twenty years, will be removed

with the plant to our new location at Chicago Heights, carefully catalogued and preserved for the benefit of our many old patrons. The general offices of the company, where all of the business heretofore conducted at the office of the works in Fort Scott, will be in the city of Chicago, No. 1,520 Monadnock Block. The works at Chicago Heights are located on the Belt Line, Elgin & Joliet Railway, Chicago, Eastern Illinois & Indiana Railway, and the Michigan Southern Railway. The Eastern office will remain at 31 and 33 Broadway, New York. There will be no change in the character or personnel of the company, and its former broad and liberal business policy will be continued. We sincerely thank our many patrons for the generous patronage and very pleasant business relations we have so long enjoyed at Fort Scott, and we solicit a continuance of the same at our new location, where we will be well equipped to improve the quality of our workman hip, reduce prices, and make unusually prompt deliveries.

Machinists' Supplies and Iron.

NEW YORK, December 28, 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $15 to $15.50; No. 2, $14 to $14 50; Gray Forge, $13 to $14. Southern brands of good quality are obtainable at $15 to $15.50 for No. 1 Foundry; $13.50 to $14 for No. 2; and $12.25 to $13 for Gray Forge.

Scotch Pig—Coltness is quoted at $21; and $30 for Eglington.

Antimony—The market is unchanged. We quote L. X. 11c. to 11⅛c.; Cookson's, 11¾c. to 11½c.; Hallett's 10¼c. to 10¼c.

Copper—The market is dull at 12¼c., asked by second hands, and 12⅜c. by companies for prompt delivery of Lake Copper. Casting Copper is held at 11⅛c. to 11¾c.

Lead—The market is steady; 3 85c. is bid, and 3.90c asked.

Lard Oil—Prime City is quoted at 87c. to 88c.; Western on spot at 85c. to 86c.

Spelter—The market is unchanged; there are sellers at 4⅜c. to 4.40c., but there is not much business.

Tin—A quiet feeling prevails, owing to the holiday season. The nominal quotations for spot and January delivery are 19.70c. to 19.75c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded

Mechanical draftsman, good designer, wants situation. Address BOX 77, AMERICAN MACHINIST.

Wanted—Draftsmen in a m'f'g establishment making mach'y & tools; state age, qualifications, exp., & expectations. P. O. Box 29, Providence, R. I.

Wanted—Foreman pattern maker, familiar with pump work Address, giving age, experience, and wages expected. BOX 71, AMERICAN MACHINIST.

Man, 35, desires position. 10 years supt. and foreman. Mach. work and hardware; steady habits; successful manager; good refs. G., AM. MACH.

Pattern maker wanted—an accurate one. Mach. wanted—one who can work close on marine work. Apply Chas. Ward, Charleston, Kanawha Co., W Va.

Wanted—Position by first-class draftsman of practical experience. Well up in modern drawing room practices Address BOX 75, AMERICAN MACHINIST.

Draftsman and machinist, with technical training, desires a position in New York or vicinity. Address BOX 8, AMERICAN MACHINIST.

First-class draftsman, with experience on large machines, and best references is open to fair offer. Address Immediate, AM. MACHINIST.

Wanted—An experienced mechanic familiar with the construction of duplex steam pumps, as foreman in erecting shop. State age, experience and references. Address B., AMERICAN MACHINIST.

Wanted—Foreman for mach. shop manufacturing cast-iron sectional boilers. One with knowledge of foundry work, particularly radiator work, preferred. H. C., AMERICAN MACHINIST.

Bradley Hammers.

If you plate, draw, square taper, swage, collar, spindle, or do any manner of die forging in iron or steel, a BRADLEY HAMMER will soon pay for itself, by what it will save over any other similar tool. Send for circulars.

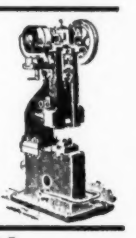
BRADLEY & COMPANY, SYRACUSE, N. Y.

HACKNEY HAMMERS

Meet all requirements more fully and satisfactorily than any other of its competitors.

INVESTIGATION IS NOT COSTLY.
INVESTIGATION IS CONVINCING.

WRITE FOR CATALOGUE TO
THE HACKNEY HAMMER CO.,
20 Johnson St., CLEVELAND, O.



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Ready Made and Made to Order.

Gear Cutting.

GRANT'S Gear Book, 15 Cents.

CEO. B. GRANT, LEXINGTON, MASS., and 125 So. 11 St., Philadelphia, Pa.

FRICTION AND LOST WORK

IN

MACHINERY AND MILL WORK.

By Prof. R. H. THURSTON.

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JOHN WILEY & SONS, NEW YORK.

The Engineering RECORD

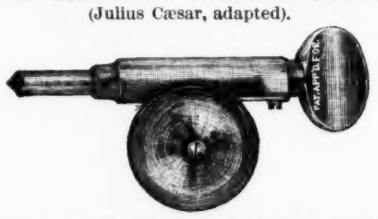
Founded fourteen years ago and prior to 1887 known as *The Sanitary Engineer*. The recognized authority on Municipal and Building Engineering. Recently enlarged by the addition of a department conducted, as is its custom, under the advice of an expert, in which notable industrial plants are regularly described and illustrated, the steam and power plants being a conspicuous feature.

Published every Saturday, $5 per year to United States, Canada and Mexico—$6 to other countries. Sample copies and list of its publications free. Address,

THE ENGINEERING RECORD,
277 Pearl Street, New York.

"THE BELL HATH STRICKEN THREE."

(Julius Cæsar, adapted).



That means the shaft revolved three hundred times, and will continue to strike every hundredth revolution. The price is low, $1.50. One will be forwarded on receipt of amount.

FRASSE & CO.,

Dealers in High Grade Tools,

90-94 Park Row, NEW YORK.

PRATT INSTITUTE,

Department Science and Technology.

Evening classes in Machine Design and in Strength of Materials will begin January 3, 1893.

Class in Machine Design will meet Monday. Tuition $5.00.

Class in Strength of Materials, Tuesday and Thursday. Tuition $8.00.

For application blanks and further particulars, address F. B. PRATT, Secretary.

STEEL TUBES

WELDLESS
SMOOTH · COLD DRAWN
John S. Leng's Son & Co. New York.

Valuable Manufacturing Property

AT AUCTION,

On Wednesday, January 11, 1893.

At 12 o'clock M., at the office of George H Burnham, No. 1 Custom House Street, Providence, R. I.

The Richmond Paper Co. Estate,

Consisting of about 28 acres of land in East Providence, R. I., three miles from the city of Providence, upon the Seekonk River and upon the Providence & Worcester Railroad, affording excellent water and railroad communication.

The **Buildings** are mainly of brick and of the following dimensions:

One building, 160x65, four stories.
One building, 200x50, one story with attic.
Two buildings, 150x60, one story.
One building, 200x30, one story.
One building, 200x40, one story.
One building, 130x60, one story.

The one story buildings are constructed with walls suitable for an additional story.

Also engine house, boiler house, water filter beds and a large boarding house and several tenements.

The **Steam Plant** consists of two Greene improved engines of 600 H. P. each, and 14 six-feet horizontal tubular boilers in good order.

The **Water Supply** is abundant and of the purest quality.

Terms of sale, five per cent. of the purchase money in cash at the time of sale and the remainder upon the delivery of the deed at the Banking House of the Rhode Island Hospital Trust Company, in the city of Providence, on the 25th day of January, 1893.

THE RHODE ISLAND HOSPITAL TRUST COMPANY, Trustee.

MONEY SAVED.

COMBINED DRILL AND COUNTERSINK FOR CENTERING LATHE WORK
Size of body 3-10 in.; Drills ⅛ in. and 3-32, or same size each end
" " 15-64 in.; " 8-100 and 7-100,
" " 13-64 in.; " 1-16 inch. Price $1.50 per doz.
J. T. SLOCOMB & CO., Providence, R. I.

VOLNEY W. MASON & CO.,
Friction Pulleys, Clutches and Elevators,
PROVIDENCE, R. I.

FOR SALE AT AUCTION,

On SATURDAY, January 21, 1893, at 10 o'clock A. M., on the premises,

FOR ACCOUNT OF WHOM IT MAY CONCERN,

THE ENTIRE EQUIPMENT OF THE

BOSTON HEATING CO.,

464 ATLANTIC AVENUE, BOSTON, MASS.

Consisting of Tubular and Sectional Boilers, about 4000 H. P.; Engines 1 to 40 H. P. each; large number of Steam Pumps, Blake's and Knowles'; Sturtevant Fan Blowers large and extra sizes, with engines. Westinghouse Dynamo, 20 Arc light. Tanks of various sizes. Lathes and Drills, large quantity of piping and valves, wrought and cast-iron, Wrought-iron smoke stacks. All shafting and pulleys, steam piping, valves and connections, in position as used by the company, all in good condition. Also, in storehouse, a very large stock of steam fitters' and machinists' tools and supplies, mostly new. 50 000 to 75,000 Dover pressed hard brick and fire brick. Ten tons Asbestos sectional and loose covering, etc., etc.

FOR PARTICULARS APPLY TO
HUBBARD BREED, 43 State St.,
E. ROLLINS MORSE & BRO., 38 State St., or to } BOSTON, MASS.
H. HARRIS & CO., Auctioneers, 227 State St.,

SEND FOR CATALOGUE.

WORCESTER MACHINE SCREW CO.

Manufacturers of Set, Cap & Machine Screws, Studs, etc

WHEN ORDERING NEW TOOLS INSIST UPON HAVING VANDERBEEK'S COUNTERSHAFT. SOME OF THE LARGEST SHOPS ARE TAKING THE OLD COUNTERSHAFTS OUT AND PUTTING OURS IN THEIR PLACES.

THE STATES MACHINE CO.,
HARTFORD, CONN.

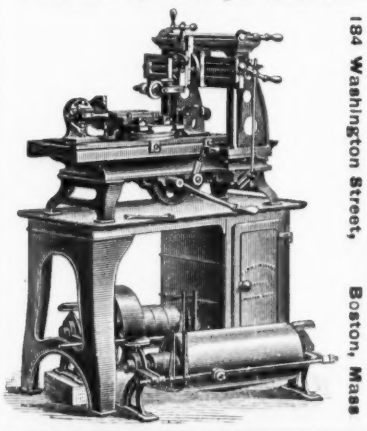
Flexible Metallic Fillet

For Pattern Makers. 8 Sizes.
H. WHITE, 44 N. 4th St. Phila, Pa.

POWER OR HAND PLANER.

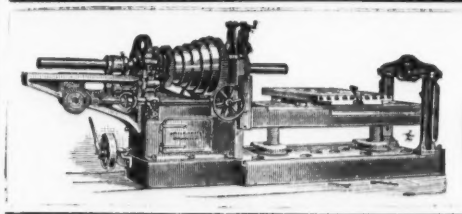
FOR MODEL MAKERS, EXPERIMENTAL WORK, &c.

Has all the Improved Features Usually Found on High Grade Planers, and is Capable of Doing the Best and Finest Work.



MANUFACTURED BY
A. J. WILKINSON & CO.,
184 Washington Street, Boston, Mass

THE BEST WORKMEN ARE USING
GROBET SWISS FILES.
MONTGOMERY & CO.,
105 FULTON ST.,
NEW YORK CITY.



BETTS MACHINE CO.,

WILMINGTON, DEL.

MACHINE TOOL BUILDERS.

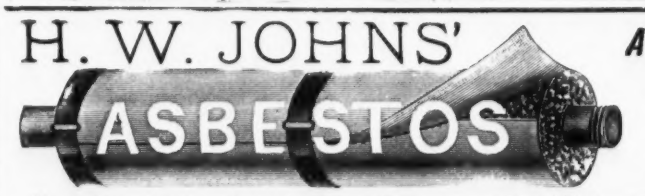
IMPROVED PATTERNS! LATE DESIGNS!

A NEW PRESSURE REGULATOR.

To meet the special requirements of elevator work, we have designed a new Pump Pressure Regulator which is positive and sensitive in its action. It is only for elevator work. As to the workmanship, we need say nothing, as all of our customers know that nothing inferior is sent out from our factory.

MASON REGULATOR CO.,
BOSTON, MASS.

H. W. JOHNS'



ASBESTOS SECTIONAL PIPE COVERINGS.

Non-Conducting Coverings for Steam and Hot Water Pipes, Boilers, etc.
ASBESTOS BOILER COVERINGS.
H. W. JOHNS MANUFACTURING COMPANY,
H. W. Johns' Asbestos Millboard, Sheathings, Building Felts, Fire-Proof Paints, Liquid Paints, Asbestos Roofing, Etc.
87 MAIDEN LANE, N. Y. JERSEY CITY, CHICAGO, PHILADELPHIA, BOSTON, ATLANTA, LONDON.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Mechanical draftsman, age 29, technical graduate, experienced in designing and erecting of machinery, wants position. Refs. Box 76, AM. MACH.

Young machinist desires private instruction from an exp. draftsman, whereby he can gain a knowledge of drawing office routine and conventionalities. X. Y. Z., 227 Madison street, New York City.

Young mechanical engineer, with varied experience as designer, desires to travel for large manufacturer of power machinery. First-class references. Moderate salary until fully identified with ability. Address Travel, AMERICAN MACHINIST.

A mechanical engineer and salesman of machinery, who controls occasional but heavy foreign orders through his connections, desires to engage with an enterprising firm for the purpose of centralizing certain foreign business during the Chicago Exhibition. X. L., AMERICAN MACHINIST.

Wanted—General foreman in a machine shop mfg. specialties; one who has had some exp. on small engine work pref'd; must be thor. competent to handle 100 men at work to best advantage; exc't opport'y for a live active young man; state age, exp., refs. & sal'y. Manufacturer, Box 260, Buffalo, N. Y.

Wanted—A thoroughly first-class shop superintendent, familiar with electrical and mechanical work, to superintend equipment and operation of new shops to be erected near New York City; applicant must have satisfactorily filled similar position in modern machine shop; must be temperate and free from other business interests, so as to be able to give his whole time to shop duties. Address by letter, stating experience, references, and salary expected, Sprague Electric Elevator Company, 15 Wall Street, N. Y. City.

JOHN BECKER MANUFACTURING CO.,

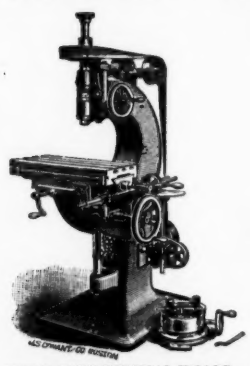
MANUFACTURERS OF

VERTICAL MILLING MACHINES,

TOOLS AND MACHINERY.

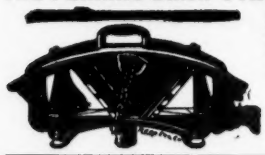
BRASS FOUNDERS

Water St., Fitchburg, Mass.



THE BECKER VERTICAL MILLER, No. 3.

THE PERKINS DRAW STROKE TRIMMER,



An Indispensable Tool for all Bench Wood workers. Latest and Best Design. Infringers Prosecuted. Trial, not orders, solicited.

PERKINS & CO., Grand Rapids, Mich.

STOCKS, NEAVE & CO., Manchester, England.

SECOND-HAND AND NEW MACHINERY.

ON HAND.

72 in. x 48 x 33 ft.	Planer	3 Heads.
54 in. x 42 in. x 24½ ft.	do	2 do
48 in. x 42 in. x 16 ft.	do	1 do
39 in. x 36 in. x 14 ft.	do	1 do
36 in. x 38 in. x 8 ft.	do	Powell A1.
30 in. x 30 in. x 8 ft.	do	1 Head.
26 in. x 24 in. x 7 ft.	do	1 do
25 in. x 24 in. x 5 ft.	do	1 do
23 in. x 21 in. x 5 ft.	do	1 do

90 in. x 30 ft. Triple Gear Engine Lathe, Ames A1
50 in. x 30 ft. Bed, Triple Geared. New Engine Lathe.
30 in. x 28 ft. D. W. Pond Shafting Lathe.

32 in. x 12, 14, 16, 18 ft.	Bed.	New	Engine	Lathe.
28 in. x 12, 14, 16, 18 ft.	do	do	do	do
21 in. x 10, 12 ft.	do	do	do	do
20 in. x 7½ & 8 ft.	do	2d Hand	do	do
18 in. x 6, 7 & 8 ft.	do	New &	do	do
17 in. x 8 ft.	do	do	do	do
16 in. x 6 & 8 ft.	do	do	do	do
15 in. x 6 & 8 ft.	do	do	do	do
14 in. x 6 ft.	do	do	do	do

Car Axle Lathe, Bement.
15, 16, 18, 25 in. Crank Shapers.
20, 24, 26 & 30 in. Geared Shapers.
20, 22 24, 28, 30 & 36 in Drills.
Bolt Cutters.
Brown & Sharpe Universal Miller.
Lot of Lincoln Pattern Millers.
No. 9 Screw Machine. Garvin.
2, 3 and 4 Spindle Drills. Garvin
No. 75 Bliss Presses.
1 Bk. Geared Miller. U. V. Co. Good.
1100 and 3000 lb. Bement Steam Hammer.
100 and 150 lb. Steam Hammer.
40 H. P. Vert. Engine. N. Y. S. S. P. Co.
11 in. x 18 in. Hor. Engine. A1 Order.
12 in. x 24 in. Corliss do do

GEO. PLACE MACHINE CO.,
120 BROADWAY, NEW YORK.

Pawling & Harnischfeger, Milwaukee, Wis.

Horizontal Drill and Boring Tools. Column Facing Lathes. Pit Lathes. Truck Wheel Grinders. Boring Bars, &c. Electric, Steam and Hand Cranes.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 25 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d-hd lathes & planers. S.M.York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes and planers. Dietz, Gang & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Lathes, tools, machinery, engines and boilers, good, at less than half price. 229, AM. MACHINIST.

Vertical boiler and engine, 10 H. P. No brickwork. $170. Tested 150 lbs. 229, AM. MACHINIST.

For Sale—Iron Planer (new) planes 8'x24"x22", $375. Patterns for Iron Planer, Wood Planers, Parallel Vises, etc., cheap. S. E., AM. MACHINIST.

Wanted—Hardware specialties to build. Send 25 cents for "Eureka Knife and Shears Sharpener." W. A. Smith & Co., 227 Eddy Street, Providence, R I.

For Sale—Screw-cutting lathe, 24"x20", with 22" chuck; good heavy tool; price $250. Zahner Bros., Sugar Creek, Ohio.

Wanted—Modern 2d-hand tools of standard make in good order. 30x30 planer, 10-foot platen, 24" swing lathe, 8 feet between centers. Kollmyer & Talbot, Keokuk, Iowa.

Special, experimental or other light machinery manufactured. Best equipped shop in the West for fine work. Manufacture one of the best hollow spindle bench lathes for the tool room or for manufacturing. Write us. Moseley & Co., Elgin, Ill.

DESIRABLE SECOND-HAND MACHINERY

LATHES.

1 17 in. x 6 ft. Blaisdell, Rise and Fall Rest, 15-in. 3-Jawed Combination Chuck, fitted.	A1 condition
1 16 in. x 6 ft. Prentice Rise and Fall Rest, 10-in. 4-Jawed Combination Chuck, fitted.	Good as new
1 15 in. x 8 ft. Fitchburg, Rise and Fall Rest, 9 in. 3-Jawed Combination Chuck fitted.	A1 condition

PLANERS.

1 30 in. x 30 in. x 8 ft. Hewes & Phillips, one Head, Spiral Geared, Fine heavy Tool.	Good as new
1 20 in. x 16 in. x 5 ft. Lincoln, with Index Centers.	Good order
1 18 in. x 22 in. Blaisdell Crank Planer.	A1 condition
1 15 in. x 15 in. x 3 ft. Planer.	A1 condition

MISCELLANEOUS.

1 22 in. Gould & Eberhardt Auto. Gear Cutter, Spur and Bevel.	Good as new
1 16 in Wright Geared Shaper.	A1 condition
1 8 in. Boynton & Plummer Shaper, with Vise.	A1 condition
1 No. 3 Garvin 6-Spindle Drill Press, with Chucks, fitted.	Good as new
1 20 in. Drill Press, Reed, Wheel and Lever, No. 2 Little Giant Chuck, fitted.	A1 condition
1 24 in Drill Press, Sliding Head, Back Gears, Wheel and Lever Feed.	Good as new
1 25 in. Barnes Drill Press, Back Geared, Power Feed.	A1 condition
1 Single-Spindle Garvin Profiling Machine.	A1 condition
1 Brown & Sharpe Surface Grinder.	Good order
1 No. 4 Garvin Milling Machine, with Arm, Vise and Arbors.	A1 condition
1 No. 2 Garvin Power Miller, with Vise.	Good as new
1 Merritt Heavy Back Geared, Miller, with Arm, Table 36 in. long, 12 in. wide, 3 "T" Slots.	Good order
1 No. 21 Bliss Adjustable Power Press.	Good as new
1 No. 2 Brown & Sharpe Screw Machine, Wire Feed.	A1 condition
1 each No. 1 and No. 2 Garvin Screw Machines, with Wire Feed.	A1 condition
400 other new and second-hand tools in stock.	Write for list and prices.

THE GARVIN MACHINE COMPANY,
LAIGHT AND CANAL STS. NEW YORK.

MACHINERY,

Improved NEW Tools.

Upright Boring and Turning Mill, 38 in. swing. "New features."
Hor. Boring and Drilling Machines, all sizes.
Universal Milling Machines. "New features."
Standard Milling Machines, all sizes, for light and heavy work. "New features."
Radial Drills, 3 to 8 ft. arms, "Stiffest" and most powerful Radials made.
Pulley Lathes, all sizes, for turning and boring at same time.
Engine Lathe, 13 in. x 6 ft. Improved style with hollow spindle, 1 1-16 in. hole, Compound Rest, Cross feed and Taper att.
Engine Lathe, 22 in. x 10-12 ft. Improved style.
Planers, 24 in. x 6 ft., 30 in. x 8 ft., 36 in. x 12 ft. "Improved styles."
Shapers, 15 and 24 in. stroke. "New features."
Boiler Bending Rolls, 8 and 10 ft., with Hinged Housings and several improvements.

Second-hand--Modern Style, A1 Order.

Brown & Sharpe Vertical Turret Chucking Machine.
Brown & Sharpe Screw Machines, complete, with Auto. Chuck and chasing-bar. A1 order.
Jones & Lamson No. 11, with 2 1-8 hole, Clutch Gears, Chasing-bar, Auto. feed, Chucks and Tools. A1 order.
Ames Engine Lathe, 20 in. x 10 ft., with Compound Rest, Cross Feed, Special reverse feature and Chuck.
Lathe and Morse Engine Lathe, 20 in. x 18 ft., with Compound Rest and Chuck.
Whitcomb Planer, 24 in. x 5 ft. Good order.
Pond Planer, 26 in. x 8 ft. Good order.
Heavy Planer, 42 in. x 9 ft. A1 order.
Shapers, 6, 8, 9, 12, 14, 15 and 24 in.
Slotting Machine, 8 in. Modern style. Auto. feeds. A1
Pratt & Whitney Profiler, 2 Spindle. A1 order.
Bliss style, No. 20 Press. A1 order.

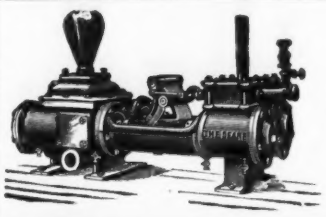
J. J. McCABE,
SUCCESSOR TO E. P. BULLARD'S N. Y. Mach'y Warerooms.
68 Cortlandt Street, NEW YORK.

ALUMINUM!

THE COWLES ELECTRIC SMELTING & ALUMINUM COMPANY,
Lockport, - New York,

Offer Pure Aluminum in Ingots, Slabs, Sheet, Wire and Castings at lowest market rates.

Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze.



THE DEANE OF HOLYOKE STEAM PUMPS

DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

CRESCENT STEEL CO'S
Pittsburgh. Chicago New York

STEEL OF THE FINEST QUALITY MADE FOR
DIES, PUNCHES, MILLING CUTTERS, TAPS, REAMERS,
AND OTHER FINE TOOLS REQUIRING GREAT ENDURANCE OF CUTTING EDGES.

A NEW SCREW PLATE. THE HANDIEST PLATE MADE.

THE FULL MOUNTED LIGHTNING.
These Plates have a stock with each die. The dies are our celebrated Adjustable **Lightning** Dies. Each Stock is of correct length and weight to suit size of die. Several sizes of dies may be in use out of same set at same time. SEND FOR CATALOGUE. Made by

WILEY & RUSSELL MFG. CO.,
GREENFIELD, MASS., U. S. A.

"R. MUSHET'S SPECIAL STEEL"

SAVES LABOR in being able to run at GREATLY INCREASED SPEEDS. FEWER GRINDINGS. No WASTE in redressing.
SOLE REPRESENTATIVES IN THE UNITED STATES,
B. M. JONES & CO.,
BOSTON: 11 & 13 Oliver St. NEW YORK: 143 Liberty St.

SEBASTIAN LATHE CO.

117 & 119 Culvert St., Cincinnati, O.

Manufacturers of Foot and Power

ENGINE AND SPEED LATHES,

For General Machine and Jobbing Shop, Electrical and Experimental Work.

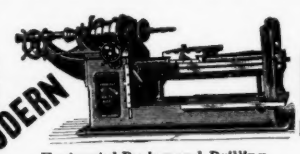
DEALERS IN MACHINISTS' TOOLS AND SUPPLIES.

FITCHBURG MACHINE WORKS,

MANUFACTURERS OF THE CELEBRATED

FITCHBURG MODERN ENGINE LATHE

AND OTHER METAL-WORKING MACHINES,



Horizontal Boring and Drilling Machine.

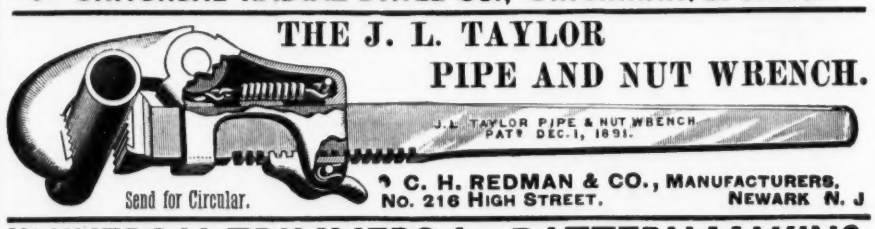
SEND FOR CATALOGUE E.

FITCHBURG, MASS.

ENGINE LATHES.

17 in. 20 in. & 30 in. Swings.
UNIVERSAL RADIAL DRILL CO., CINCINNATI, O. U.S.A.

THE J. L. TAYLOR PIPE AND NUT WRENCH.



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C. H. REDMAN & CO., MANUFACTURERS,
No. 216 HIGH STREET. NEWARK N. J

UNIVERSAL TRIMMERS for PATTERN MAKING.

ALL SIZES AND STYLES, NEW AND SECOND-HAND.
Each machine inspected, and guaranteed to be in perfect working order, before shipment.
RANGING IN PRICE FROM $10.00 UPWARDS.
S. L. CROCKETT, Mfrs. Agent.
BOX 138. DETROIT, MICH.

JESSOP'S STEEL

FOR TOOLS, DRILLS, DIES, &c.

ALL KINDS IN STOCK.
Manufactory, SHEFFIELD, ENG.
Chief Am. Office, 91 JOHN ST., N. Y.
WM. JESSOP & SONS, LD.

Experimental Work of every Description,

Mechanical and Electrical. Contractors for the manufacture of specialties, or can furnish complete plants for their manufacture. Make Dies, Special Tools, Gauges, Drawings, Patterns, Models. Inventions perfected. Estimates furnished. Correspondence solicited.

Send for Circular of our SENSITIVE KNEE DRILL.
BRADY M'F'G. CO. 83 Washington St., BROOKLYN, N. Y.

BRIDGEPORT MACHINE TOOL WORKS

LATHES

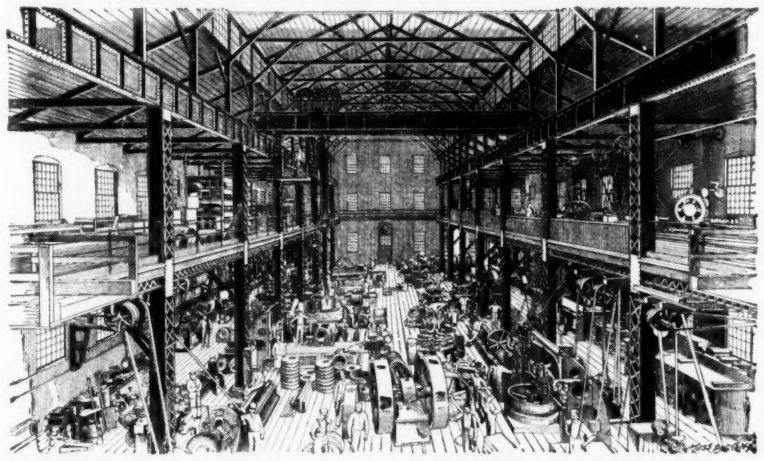
E. P. Bullard, Propr. Bridgeport, Conn

DON'T ACCEPT ANY SUBSTITUTE FILE.
INSIST ON HAVING
NICHOLSON.

NICHOLSON FILE CO.
PROVIDENCE, R. I., U. S. A.

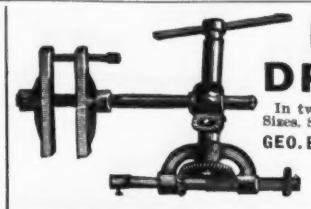
3000
VARIETIES FILES
[X. F.] & INCREMENT CUT FILES.

THE BERLIN IRON BRIDGE CO.
Office and Works:
No. 8 Railroad Ave., East Berlin, Conn.
CHAS. M. JARVIS, Pres. and Chief Engineer. BURR K. FIELD, Vice-President.
FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary.

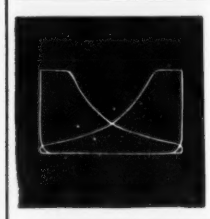


The above illustration is taken direct from a photograph and shows the interior of a Machine Shop designed and built by us for the Ball & Wood Co., at Elizabethport, N. J. The building is 80 ft. in width by 180 ft in length. The central portion is 40 ft. from center to center of traveling crane rails, while the two-story wings on each side are 20 ft. in width. We built this entire building, including the brick work and foundations, the whole complete ready for the masonry.

SEND FOR OUR ILLUSTRATED CATALOGUE.



CLAMP DRILLS
In two Styles and four Sizes. Send for circular to
GEO. BURNHAM & CO.,
Worcester, MASS.



HOME STUDY OF MECHANICS AND MECHANICAL DRAWING.
No time need be lost from work.
Send for FREE Circular to The Correspondence School of Mechanics, Scranton, Pa.

C. W. LE COUNT,
SOUTH NORWALK, CONN.

REDUCED PRICE OF LE COUNT'S HEAVY STEEL DOG

No.	Inch.	Price.
1	3-8	$ .40
2	1-2	.50
3	5-8	.60
4	3-4	.60
5	7-8	.70
6	1	.70
7	1 1-8	.80
8	1 1-4	.80
9	1 3-8	.90
10	1 1-2	.90
11	1 3-4	1.10
12	2	1.20
13	2 1-4	1.35
14	2 1-2	1.45
15	3	1.50
16	3 1-2	1.80
17	4	2.10
18	4 1-2	2.75
19	5	3.25
Full set of 19		$23.60
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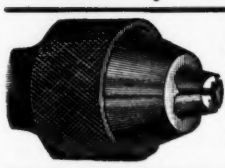

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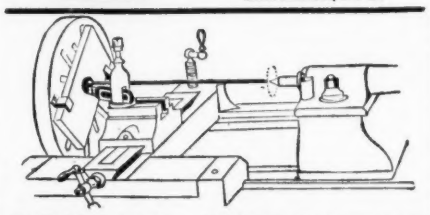

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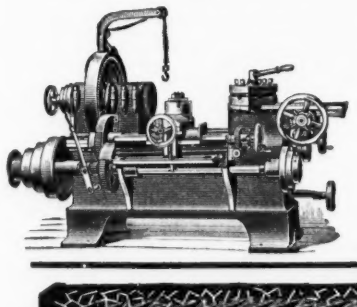

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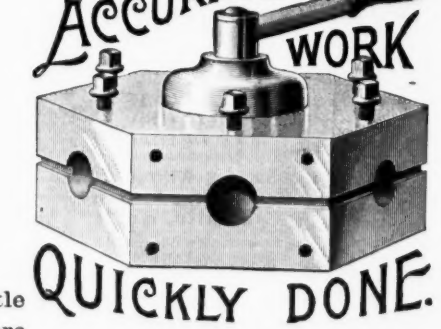

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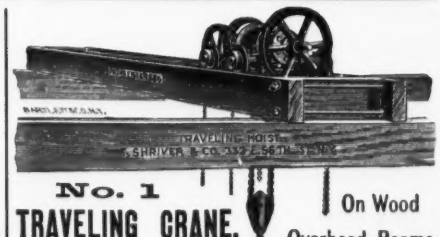

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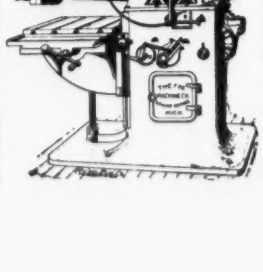

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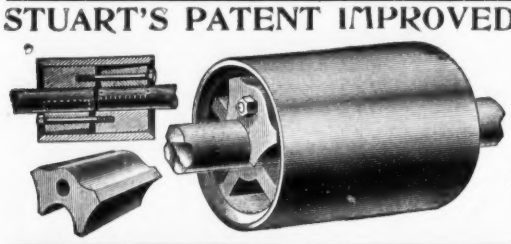

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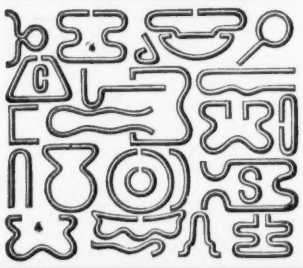

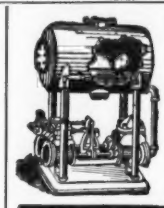

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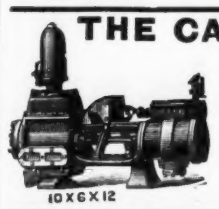

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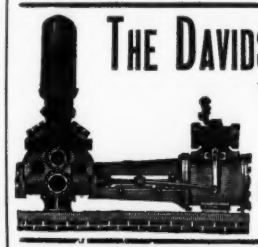

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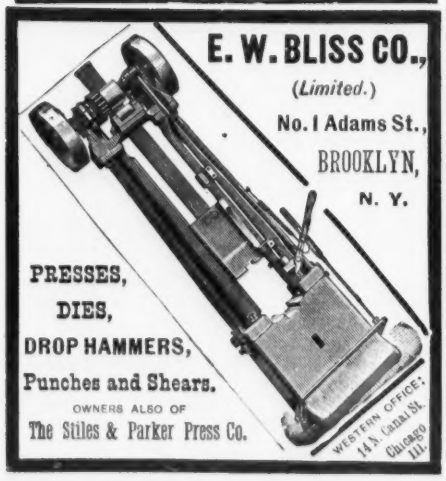

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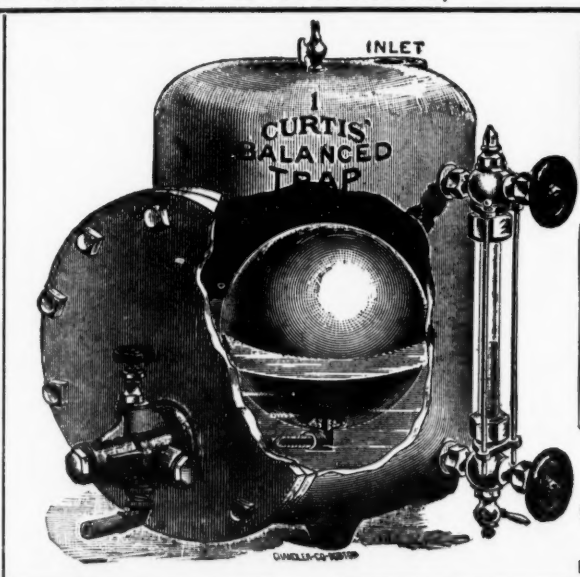

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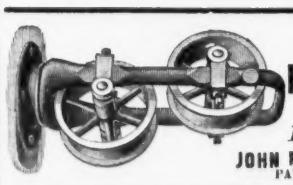

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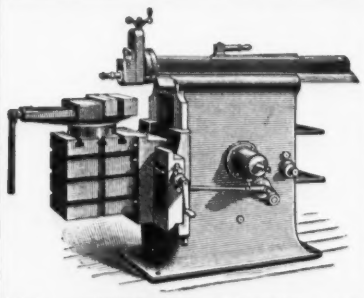

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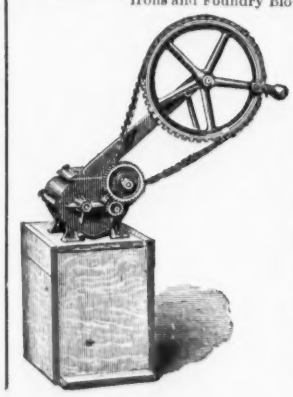

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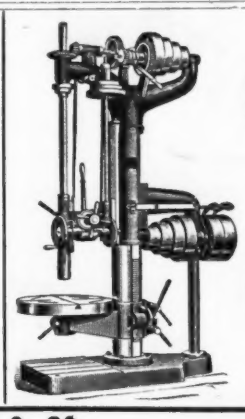

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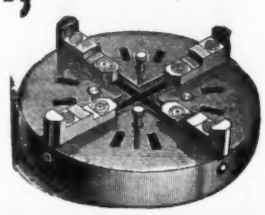

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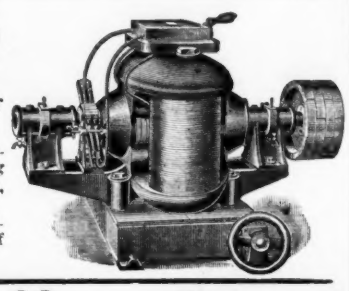

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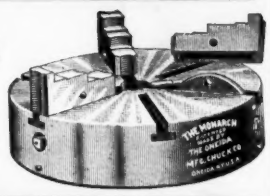

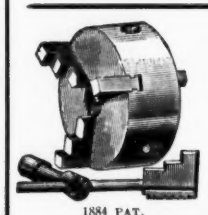
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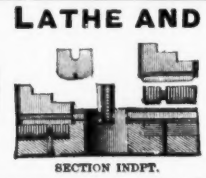
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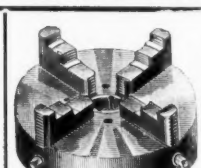
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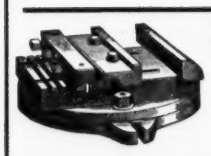

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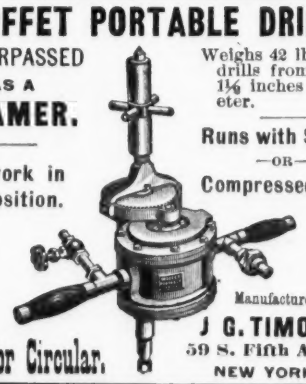

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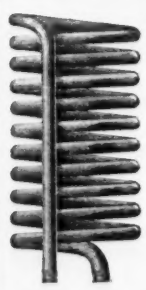

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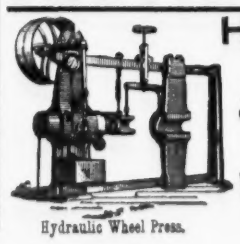
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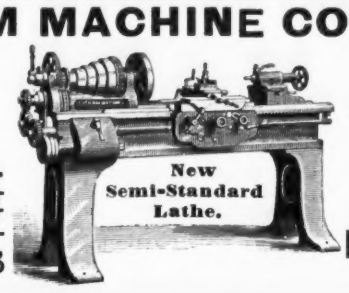

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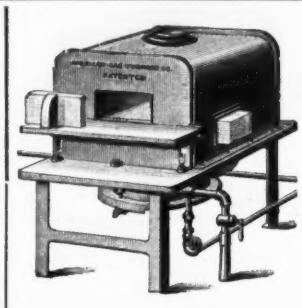

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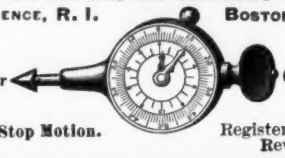

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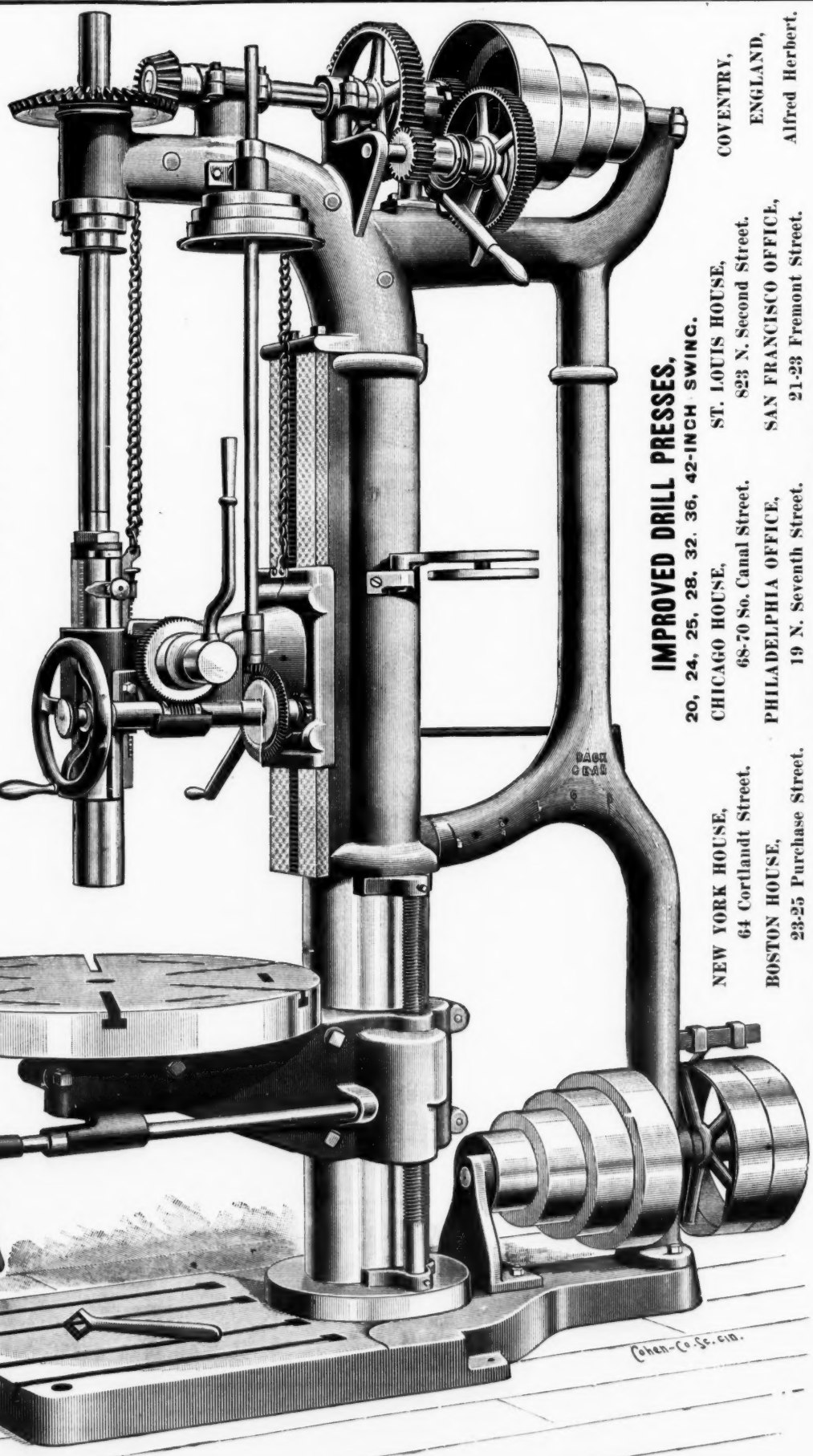

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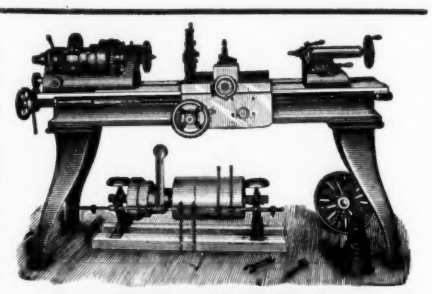

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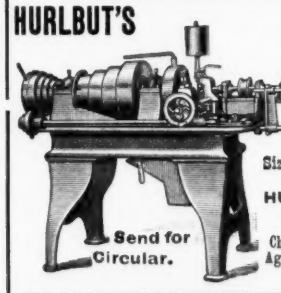

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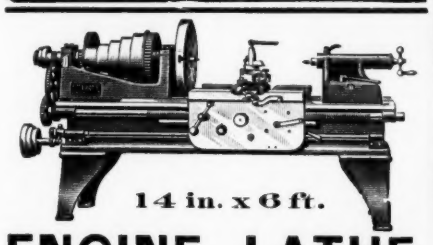

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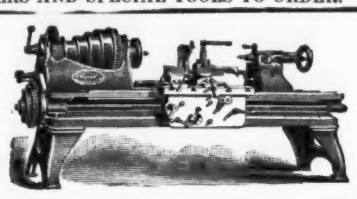

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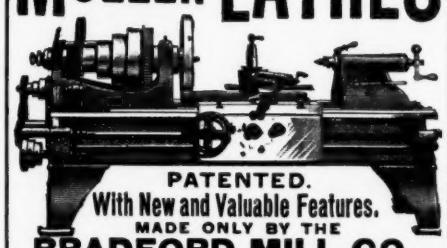

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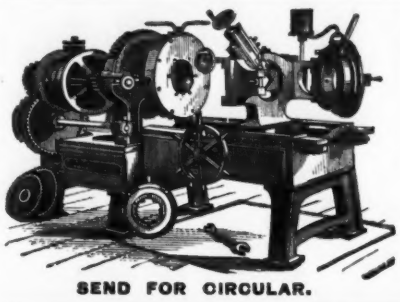

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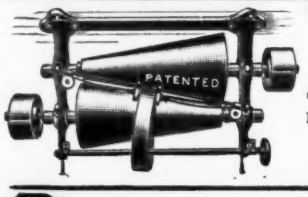

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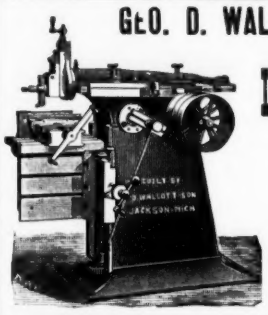

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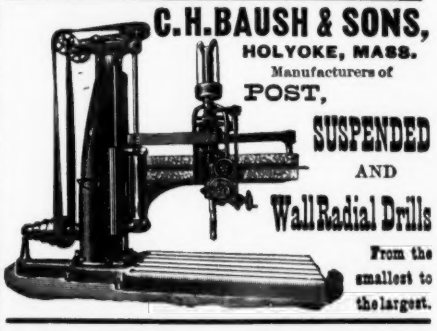

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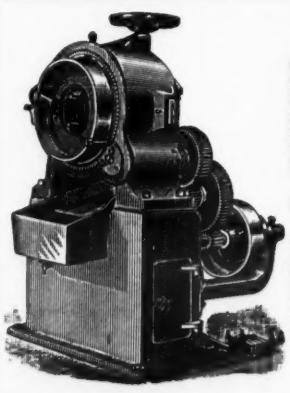

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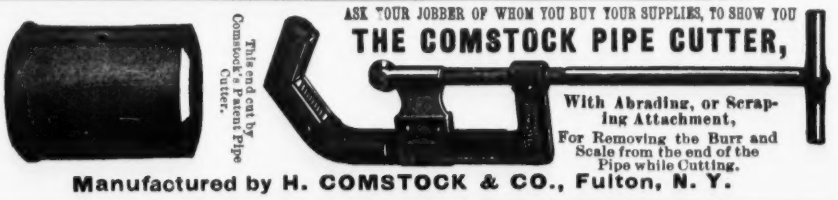

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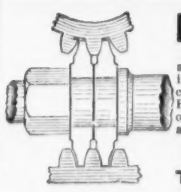

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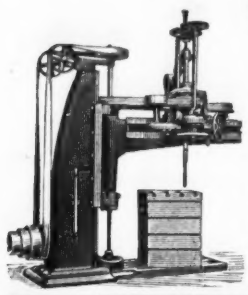

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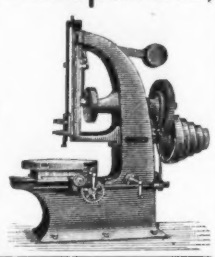

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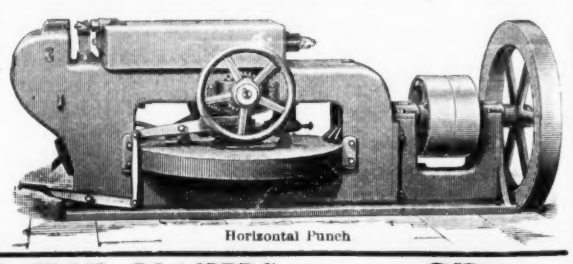

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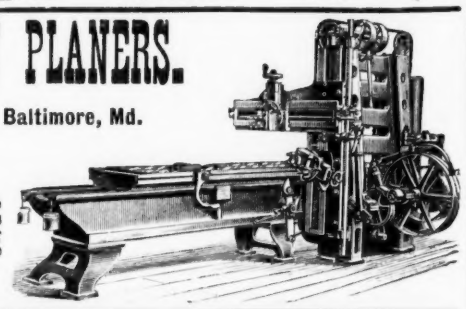

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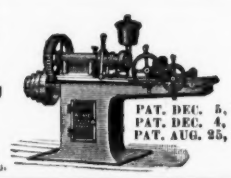

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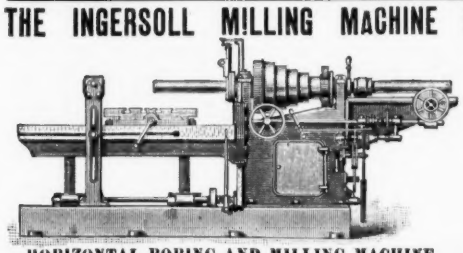

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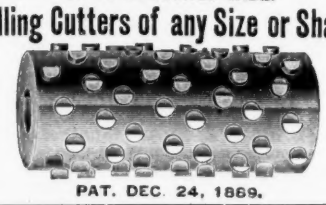

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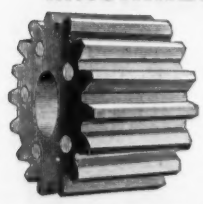

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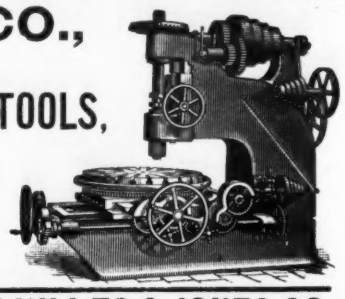

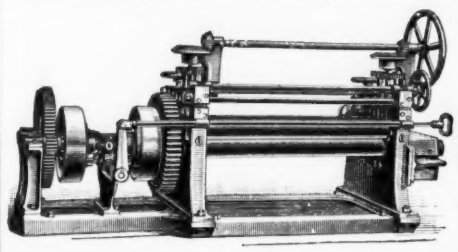

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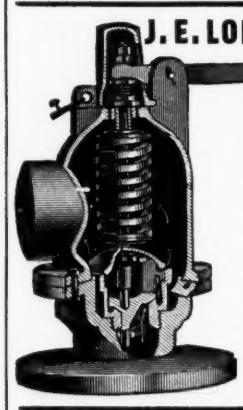

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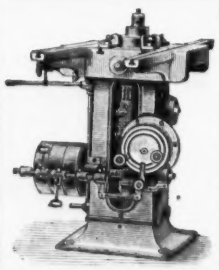

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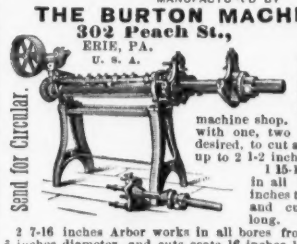

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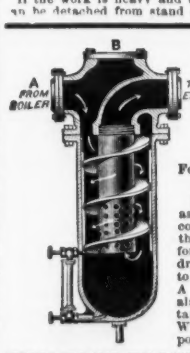

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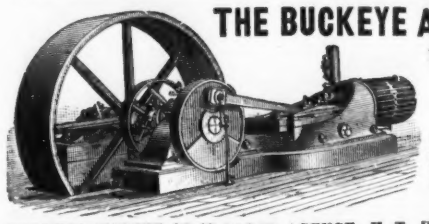

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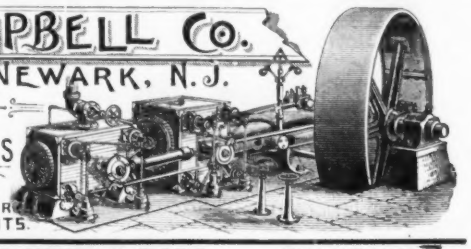

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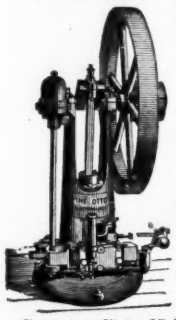

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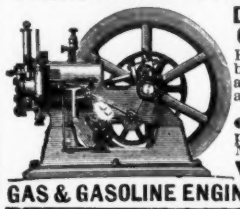

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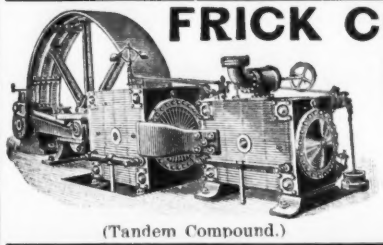

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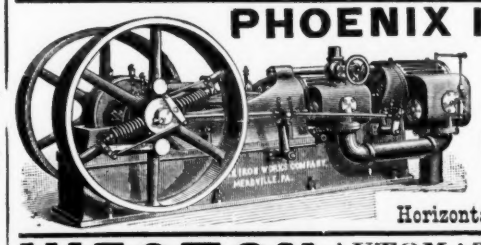

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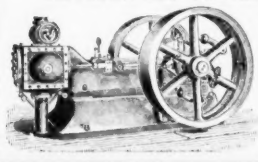

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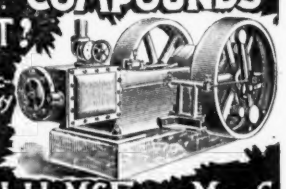

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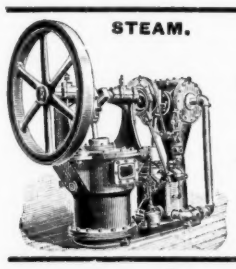

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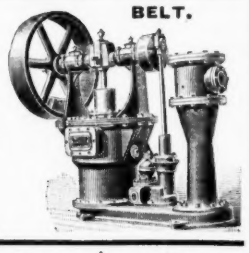

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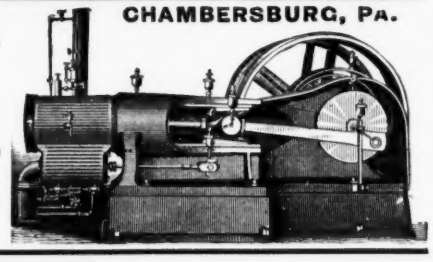

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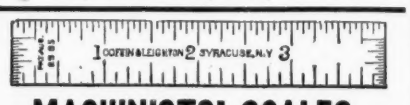

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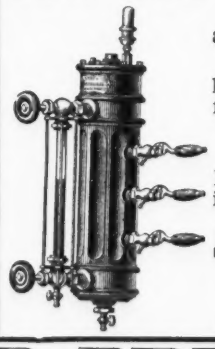

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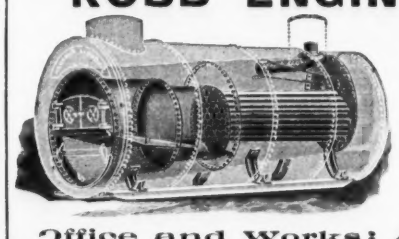

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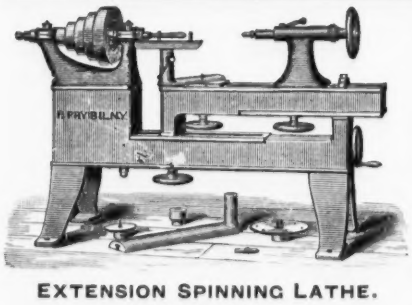

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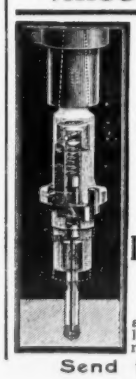

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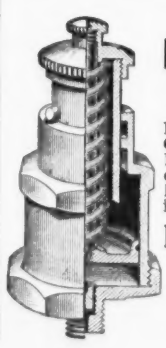

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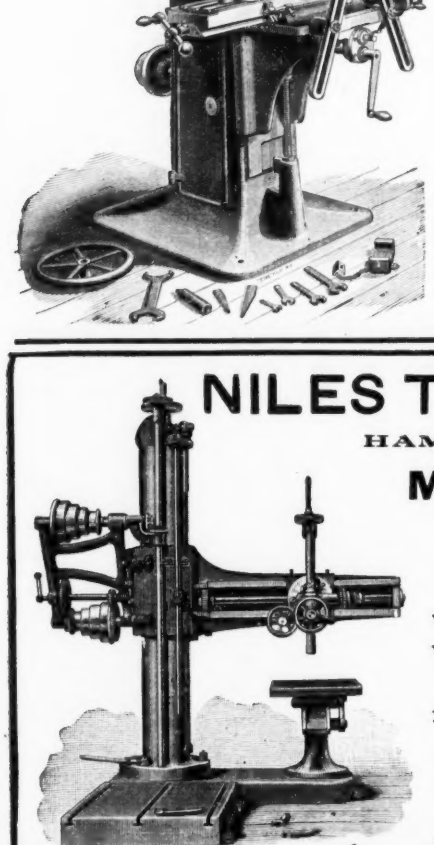

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takes the place of the No 1 Universal Milling Machine when it is not desired to cut spirals or use an index head.

The overhanging arm supports the outer end of the cutter arbor, either on a center or in a bushing, and may be rigidly connected with the knee by an arm brace. The saddle rests directly upon the knee, and has a movement of 6¾" in line with the spindle. The platen is 32" long, 7" wide, and can be lowered 18½" from the center of the spindle. It has an automatic feed of 20".

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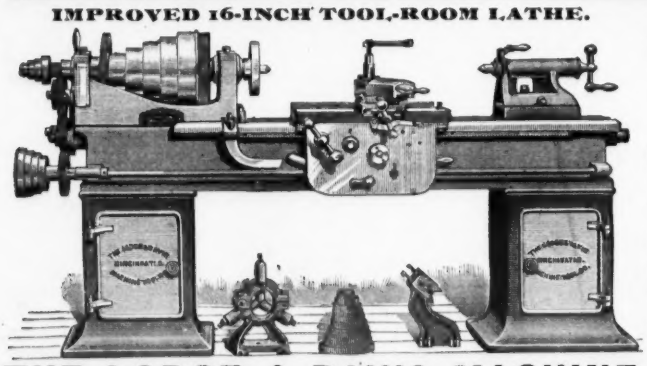

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Lead Screw Inside.
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See advertisement, page 16.

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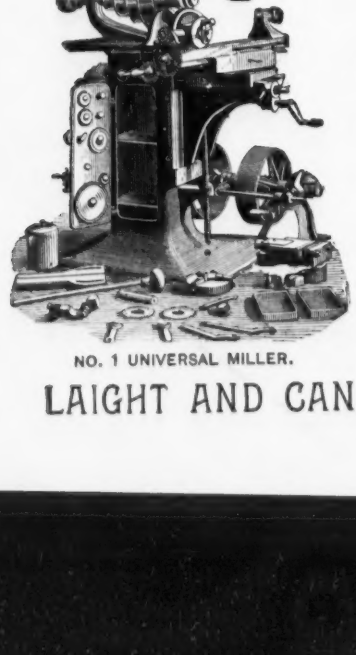

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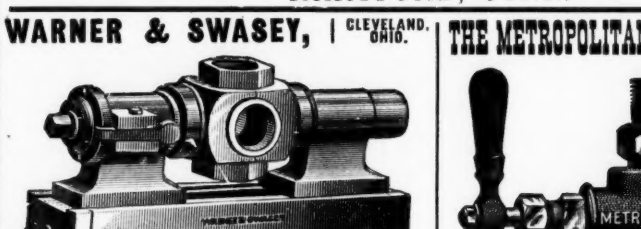

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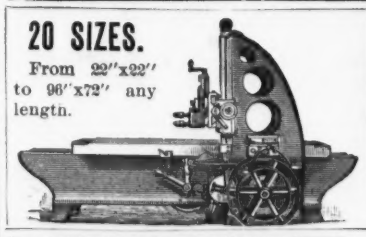

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